Huron Manistee National Forests
Non-native Invasive Plant Control Project

Environmental Assessment

Huron-Manistee National Forests
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Purple Loosestrife

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Chapter 1 PURPOSE AND NEED FOR TAKING ACTION

The purpose and need for taking action to control the spread of non-native invasive plants (NNIP) on Huron-Manistee National Forests (HMNF) is described in this chapter. This chapter begins by providing an introduction to the problem.

1.1 INTRODUCTION TO THE PROPOSAL

The HMNF are developing an integrated program for the control of non-native invasive plant (NNIP) infestations on the Forests. A variety of control methods including manual, mechanical, chemical, cultural, and biological controls are under consideration. This programmatic Environmental Assessment (EA) evaluates the potential environmental effects for these control methods, including effects from Proposed Actions on the human environment (40 CFR 1508.9).

The EA has been prepared in compliance with the National Environmental Policy Act (NEPA) and the Council on Environmental Quality (CEQ) regulations (Regulations) for implementing NEPA (40 CFR 1500-1508). Under these Regulations, an EA is defined as a "….public document…that serves to briefly provide sufficient evidence and analysis for determining whether to prepare an environmental impact statement or a finding of no significant impact" (40 CFR 1508.9).

An interdisciplinary team (IDT) of resource specialists has prepared this EA which includes analyzing the effects of the proposed action and alternatives. This EA discloses the direct, indirect, and cumulative environmental effects that would result from the proposed action and alternatives. Impacts are presented in a comparative format, which is intended to allow the reader to discriminate between the positive and negative attributes of each alternative. Based on this EA, and other relevant information, the Forest Supervisor will decide whether or not to adopt the proposed measures to control NNIP species on the HMNF.

1.1.1 PROJECT AREA

Lying between the shores of Lake Michigan and Lake Huron in the northern half of the Lower Peninsula of Michigan, the nearly million-acre HMNF are located in a transition zone between forested lands to the north and agricultural lands to the south (See Figure 1-1 and Figure 1-2). The Huron-Manistee National Forests are two distinct units in the Lower Peninsula of Michigan. The Huron unit on the east side of the state is approximately 60 miles wide east to west and from 12 to 30 miles long north to south. It touches Lake Huron near East Tawas and north of Harrisville. The Manistee unit on the west side of the state is approximately 40 miles wide east to west and 75 miles long north to south. A portion lies alongside Lake Michigan near Manistee. Together the Forests contain about 970,000 acres of National Forest System lands within proclamation boundaries which encompasses approximately 2,021,090 total acres.

Formed by glaciers thousands of years ago, these lands are characterized by relatively low relief, abundant sand and clear water, and diverse forests. The HMNF contain rare ecological features, such as dry sand prairie remnants, coastal marshlands, dunes, oak savannahs, fens, bogs, and marshes.

Water resources on the HMNF include 1,800 miles of streams and 17,000 acres of lakes. The HMNF contain legendary high quality, cold water river systems of national significance. Each spring and fall, thousands of steelhead and salmon migrate to HMNF streams and rivers, making this one of the most popular fisheries in the State of Michigan. The HMNF are also recognized as the premier Forest for river watercraft use, including outfitters and guides.

Figure 1-1. Location of the Huron-Manistee National Forests with respect to the Great Lakes (Forests are shaded in dark grey).

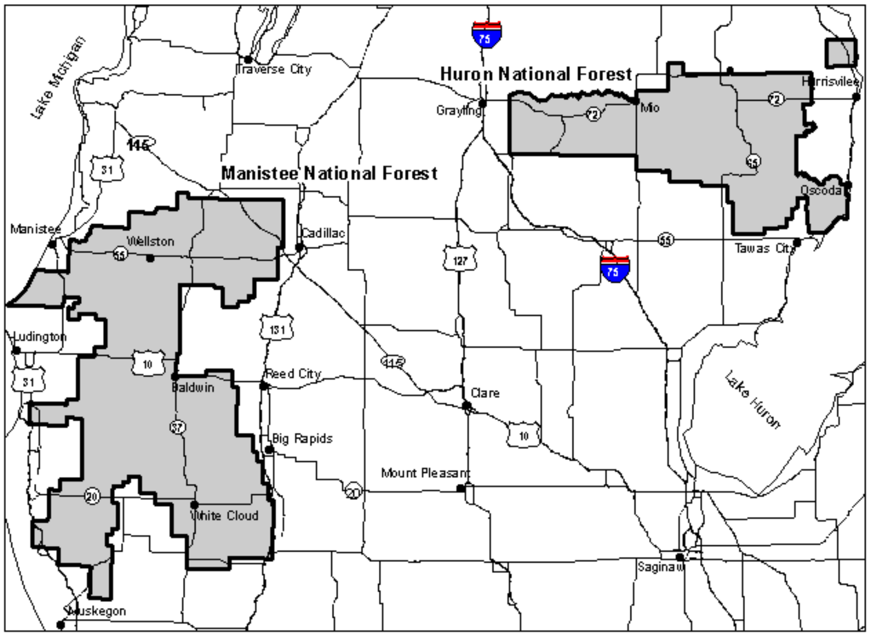


Figure 1-2. Map depicting the detailed location of the Huron-Manistee National Forests.

Ensuring long-term forest health is a management priority. The HMNF vegetation management program is the primary tool for restoring and providing a diverse range of sustainable habitats for many species, supporting forest health, and providing wood fiber.

The HMNF provide unique habitats for a variety of Sensitive plant and animal species. The Forest Service manages approximately one-half of known breeding habitats in the United States for the Endangered Kirtland's warbler. The HMNF provide critical habitat for other Endangered and Threatened species such as piping plover, Pitcher's thistle, and Karner blue butterfly. In addition, the HMNF provide habitat for a variety of game species such as ruffed grouse, white-tailed deer, and eastern wild turkey. Approximately 35 percent of licensed hunters in Michigan hunt on the HMNF.

Jack pine forests, one of the most volatile fuel types, are intermingled across private and National Forest ownership. These fire-adapted forests create the potential for fast moving, intense, wind-driven crown fires such as the Mack Lake Fire of 1980 which burned over 24,000 acres within six hours. The HMNF have initiated a program to lessen fire risk within this "wildland-urban interface," because of increasing human occupation of the area.

Publicly-and privately-owned mineral resources such as oil and gas, and sand and gravel are found on the HMNF. The HMNF are required to provide opportunities for development of these privately-owned resources where such use can be performed in an environmentally safe and sound manner.

The HMNF serve as a "backyard" playground for many Midwest residents. Much of HMNF lands are intermingled between private and state lands. Over 60 million people are within a day's drive of experiencing HMNF recreation opportunities. Due to their proximity to population centers, and their dense road and trail networks, the HMNF offer extensive year-round outdoor activities including hunting, fishing, off-road vehicle use, biking, driving for pleasure, camping, hiking, snowmobiling, river use, and berry picking, mushrooming, and plant gathering.

Scattered private land ownership within and adjacent to the Forests' proclamation boundary, and heavy recreational use on the HMNF, make it difficult to achieve management objectives for controlling the spread of NNIP species. A complex network of roads, in combination with high traffic density, provides corridors for the spread of invasive plants across the Forests. Landowners within HMNF boundaries unknowingly provide continual sources of such popular ornamentals as purple loosestrife and non-native honeysuckles, which are both highly invasive. A disregard of road closures by some users, unauthorized off-road vehicle use, and other unauthorized activities (such as dumping yard waste) provide avenues of NNIP spread in both upland and wetland areas.

The HMNF manage an active invasive plant prevention and education program. Forest and public education emphasizes NNIP identification and prevention methods. On-the-ground actions generally follow United States Department of Agriculture (USDA) guidance: *Forest Service Guide to Noxious Weed Prevention Practices* (USDA Forest Service 2001a). Non-invasive and native plant species are used to reseed disturbed ground following project activities. Non-native invasive plant inventories are conducted during pre-project resource surveys. Steps are often taken, such as equipment inspection and cleaning, and pre-treatment of invasive plants before timber harvesting, to reduce or eliminate spread of invasive seeds or propagules (e.g., structures that can give rise to new organisms) during project implementation.

In recent years, NNIP control has become a Forest Service priority at national, regional and Forest levels. On the HMNF, priority target NNIP includes:

autumn olive	Elaeagnus umbellata
garlic mustard	Alliaria petiolata
hounds-tongue	Cynoglossum officinale
Japanese and common barberry	Berberis thunbergi and B. vulgaris
non-native honeysuckles	Lonicera spp
phragmites (common reed)	Phragmites australis
purple loosestrife	Lythrum salicaria
spotted knapweed	Centaurea maculosa

Invasive plants on the HMNF are currently spread by a variety of methods. Exotic honeysuckles, autumn olive, and Japanese barberry all have fruits that are dispersed primarily by birds. Other species are spread largely by wind, animals, water currents, or inadvertently by people on their clothes or vehicles. Transporting soil or gravel infested with weed seeds also contributes to the spread of invasive plants along roads and in parking lots.

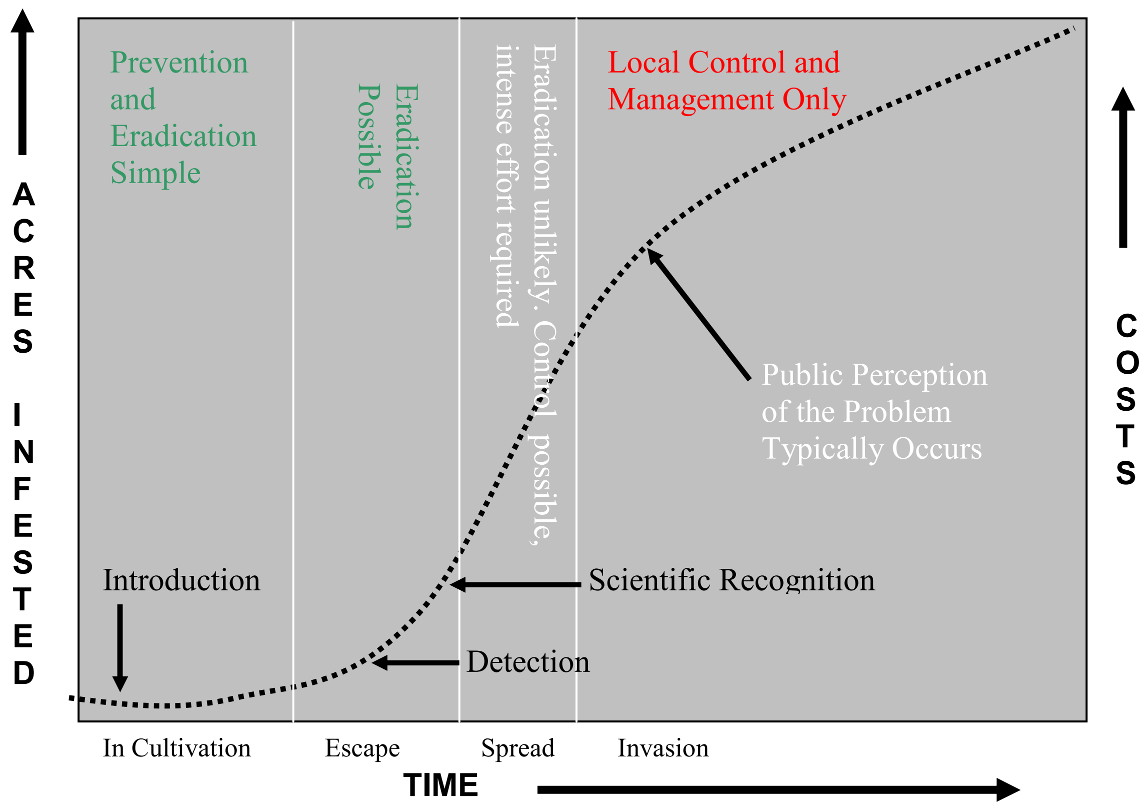
The HMNF Non-Native Invasive Species Framework is tiered to the Forest Service Region 9 Non-Native Invasive Species Framework and the FS National Strategy and Implementation Plan for Invasive Species Management outline NNIP program strategies and is predicated on the following elements:

1) Prevention—Stop invasive species before they arrive.
2) Early detection and rapid response (EDRR)—Find new infestations and eliminate them before they become established.
3) Control and management—Contain and reduce existing infestations.
4) Rehabilitation and restoration—Reclaim native habitats and ecosystems.(USDA Forest Service 2004f).

Management direction is further elaborated in section 1.2 on Management Direction and is only partially displayed to provide an introductory framework to illustrate the management niche this proposed program would fill.

The proposed project analyzed in this document is the tool which would specifically address element number two: Early Detection and Rapid Response (EDRR). The science of invasive species is discussed in a wide variety of literature and is aptly summarized in the Forest Service National Strategy and Implementation Plan for Invasive Species Management cited above (USDA Forest Service 2004f). The heavy emphasis on elements one and two are predicated upon the scenario illustrated in the figure below: that of an undetected presence of an invasive species followed by a period of rapid population expansion. As indicated in the figure, a cost effective and biologically successful program for addressing NNIP is found in the earlier stages of NNIP infestation.

Figure 1.3. Relationship of Non-Native Invasive Plant Population Dynamics and Natural Resource Management Effectiveness Based Upon Timing and Costs for Eradication or Suppression Control



Due to the vast acreage under management by the HMNF, the proposed program also provides a tiered approach to implementing the National, Regional and HMNF NNIP frameworks. There are two levels of priority identified for treating NNIP on the HMNF. One level of prioritization is addressed by the assessment of impact risk level from each potential invasive plant species. The result is the list of HMNF NNIP species which have been determined to have an ecological risk factor. Table 1-1 indicates a ranking system established by the HMNF for those NNIP determined to pose a risk to ecosystem health on the Forests. The ranking system is based upon several factors including current level of presence on the Forests and whether or not the area under consideration for NNIP prevention or treatment is a high priority area.

Table 1-1. Huron-Manistee National Forests NNIP Species.

Common Name	Species	Forest Category	Classified by Michigan State		Common Name	Species	Forest Category	Classified by Michigan State
Norway maple	Acer platanoides	3			Spreading star thistle	Centaurea diffusa	5	
Tree-of-heaven	Ailanthus altissima	1			Spotted knapweed	Centaurea maculosa	4	
Garlic mustard	Alliaria petiolata	2			Russian thistle	Centaurea repens	5	
Wild garlic	Allium vineale	5			Canada thistle	Cirsium arvense	4	S
Common burdock	Arctium minus	4			Marsh thistle	Cirsium palustre	1	
Yellow rocket	Barbarea vulgaris	4	S		Bull thistle	Cirsium vulgare	4	
Common barberry	Berberis vulgaris	2			Field bindweed	Convolvulus arvensis	5	S
Japanese barberry	Berberis thunbergii	2			Purple crown vetch	Coronilla varia	2	
Hoary alyssum	Berteroa incana	4	S		Flax dodder	Cuscuta epilinum	5	S
Indian mustard	Brassica juncea	5	S		Clover dodder	Cuscuta epithymum	5	S
Black mustard	Brassica nigra	5	S		Hounds-tongue	Cynoglossum officinale	5	
Smooth brome	Bromus inermis	4			Orchard grass	Dactylus glomerata	4	
Flowering rush	Butomus umbellatus	1			Queen Anne's Lace	Daucus carota	4	S
Musk thistle	Carduus nutans	1			Autumn olive	Elaeagnus umbellata	4	
White sweet clover	Melilotus alba	4			Cypress spurge	Euphorbia cyparissias	5	
Yellow sweet clover	Melilotus officinalis	4			Leafy spurge	Euphorbia esula	3	
Eurasian water-milfoil	Myriophyllum spicatum	4			Baby's breath	Gypsophila paniculata	1	
Wild parsnip	Pastinaca sativa	1			Perennial sow thistle	Sonchus arvensis (uliginosus)	5	S
Reed canary grass	Phalaris arundinacea	4			Common tansy	Tanacetum vulgare	5	
Common reed	Phragmites australis	3			Wild parsley	Torilis japonica	5	
Scots pine	Pinus sylvestris	4			Periwinkle	Vinca minor	4	
Japanese knotweed	Polygonum cuspidatum	1			Giant hogweed	Heracleum mantegazzianum	1	
White poplar	Populus alba	3			Common St. John's-wort	Hypericum perforatum	4	

Common Name	Species	Forest Category	Classified by Michigan State		Common Name	Species	Forest Category	Classified by Michigan State
Lombardy poplar	Populus nigra	3			Lathco flatpea	Lathyrus sylvestris	5	
Curly pondweed	Potamogeton crispus	4			Amur honeysuckle	Lonicera maackii	2	
Common buckthorn	Rhamnus cathartica	1			Morrow's honeysuckle	Lonicera morrowii	2	
Smooth buckthorn	Rhamnus frangula	1			Tatarian honeysuckle	Lonicera tatarica	2	
Black locust	Robinia pseudoacacia	5			Whitebell honeysuckle	Lonicera x bella	2	
Multiflora rose	Rosa multiflora	2			Purple loosestrife	Lythrum salicaria	3	

TABLE LEGEND

Forest Category

1=not on Forests yet; eradicate new occurrences immediately upon discovery

2=eradicate wherever found
3=control source populations, eradicate outliers
4=prevent invasion of last areas not invaded, eradicate high priority areas
5=status on Forest uncertain, control/eradication site specific

S = State of Michigan Noxious Weed

Number of Species by Category
1 = 10; 2 = 9; 3 = 7; 4 = 17; 5 = 15

The second level of prioritization for NNIP treatment on the HMNF depends upon the management objectives for the specific geographic location under consideration for treatment. Due to the large number of acres under management by the Forest, areas deemed "high priority" are given the first or highest level of consideration for NNIP eradication and control efforts. These areas are indicated in Figure 1-4 and Figure 1-5.

High priority areas include Wilderness, Wild and Scenic Rivers, Research Natural Areas, and recreational trails. Other areas may be high priority on a case-by-case basis on each of the Districts during the implementation phase of this proposed project. Such examples would include the restoration or maintenance of habitat for Threatened, Endangered or Sensitive species.

Figure 1-4. Priority Non Native Invasive Plant Treatment Areas on the Manistee National Forest.

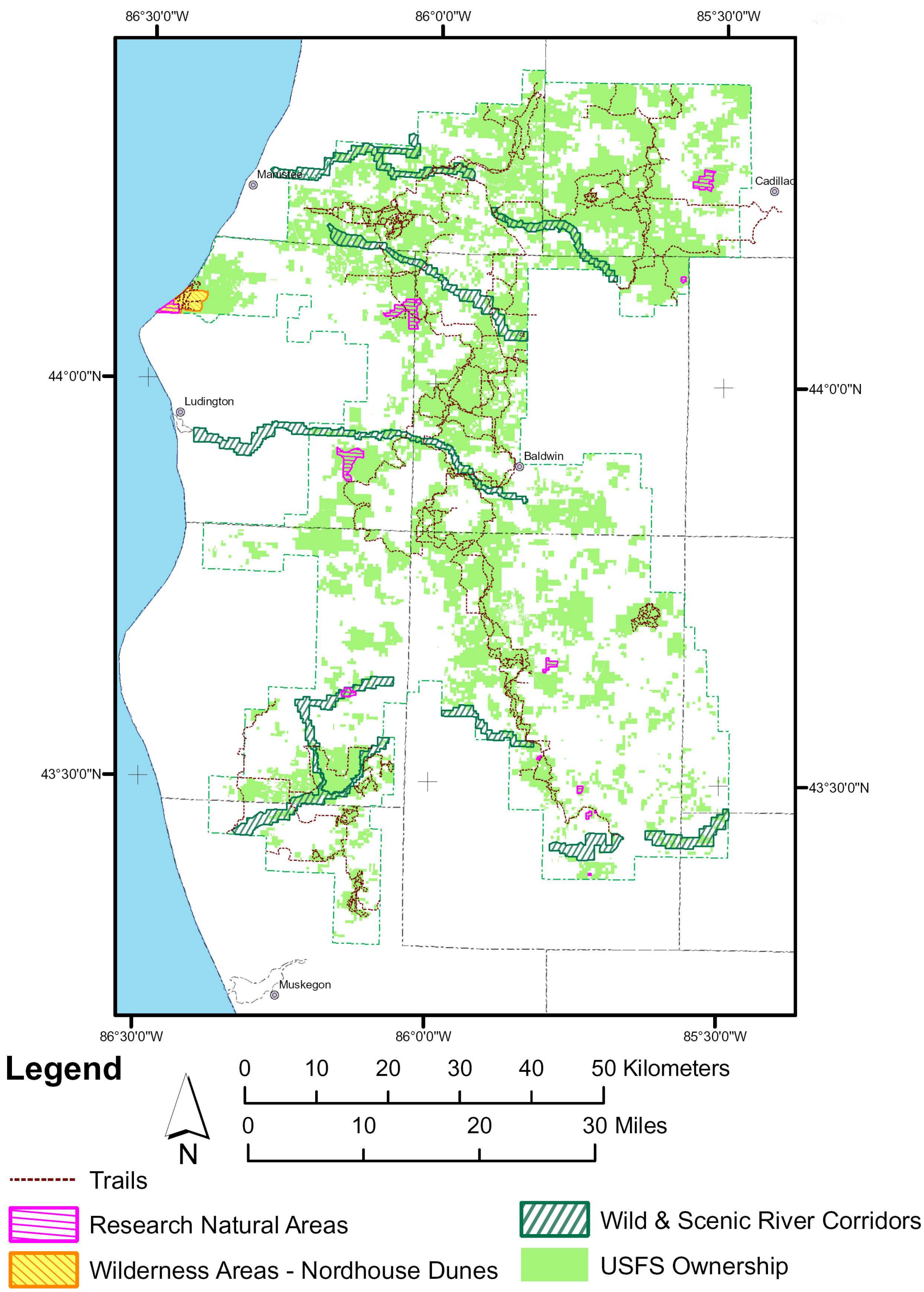
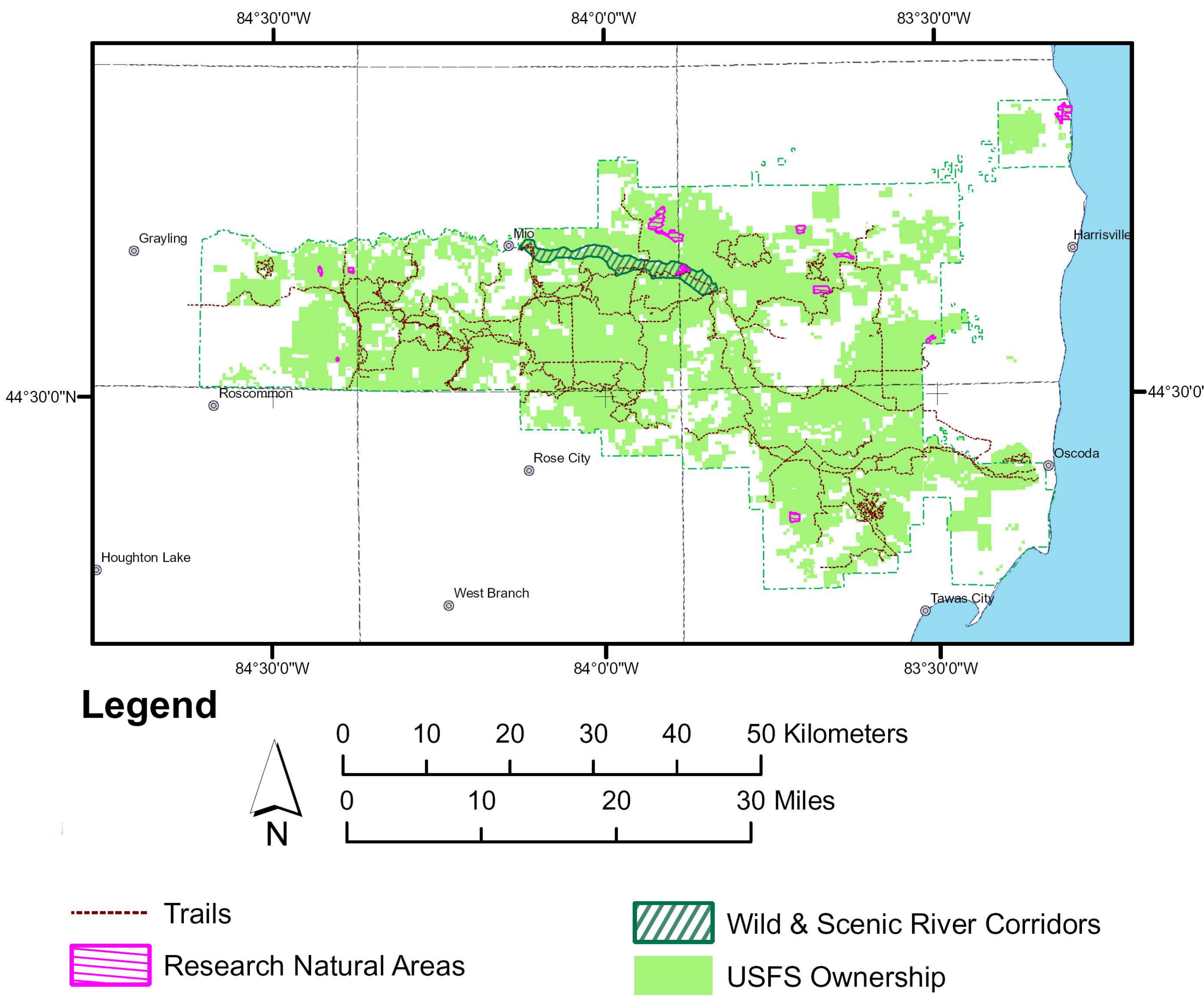


Figure 1-5. Priority Non Native Invasive Plant Treatment Areas on the Huron National Forest.



The current level of infestation that is estimated for the Forests is shown in Table 1-2. In general, infestations have been found to be associated with areas of ground disturbance, roadsides, and areas receiving concentrated human uses such as campgrounds and fishing access locations.

Table 1-2. Estimated Levels of NNIP Infestations on the Huron-Manistee National Forests.

	2002 Percent Infested	2002 Acres Infested	Projected 3% Annual Increased Spread by 2008 (acres)
Roadsides	80%	10,000	12,000
Landtype Associations* 1 and 2	10 %	60,000	73,000
Riparian Areas	5 %	5,000	6,000
Other LTAs	3 %	9,000	11,000
Total		84,000	102,000

* Landtype Associations 1 (Outwash Plains) and 2 (Ice Contact Hills) are explained in the Forests' Ecological Classification and Inventory System of the Huron-Manistee National Forests (Cleland et al., 1994).

1.2 MANAGEMENT DIRECTION

Federal agencies including the Forest Service have many sources of direction for controlling invasive species that are having or have the potential to result in deleterious environmental effects. Specific regulatory direction pertinent to controlling HMNF noxious weeds and invasive plants is summarized below.

Executive Order 13112

Under this Executive Order, each Federal agency whose actions may affect the status of invasive species shall, to the extent practicable and permitted by law:

1) Identify such actions;

2) Subject to the availability of appropriations, and within Administration budgetary limits, use relevant programs and authorities to:

   (i) prevent the introduction of invasive species;
   (ii) detect and respond rapidly to and control populations of such species in a cost-effective and environmentally sound manner;
   (iii) monitor invasive species populations accurately and reliably;

(iv) provide for restoration of native species and habitat conditions in ecosystems that have been invaded;
(v) conduct research on invasive species and develop technologies to prevent introduction and provide for environmentally sound control of invasive species; and
(vi) promote public education on invasive species and the means to address them.

Forest Service Manual 2080.2

This Manual provides direction for implementing an integrated weed management program to control and contain the spread of noxious weeds on National Forest System lands and from National Forest System lands to adjacent lands. Specific objectives include:

1) Prevention of the introduction and establishment of noxious weed infestations.
2) Containment and suppression of existing noxious weed infestations.
3) Formal and informal cooperation with state agencies, local landowners, weed control districts and boards, and other federal agencies in the management and control of noxious weeds.
4) Education and awareness of employees, users of National Forest System lands, adjacent landowners, and State agencies about noxious weed threats to native plant communities and ecosystems.

Forest Service Manual 2081.2 - Prevention and Control Measures.

This Manual provides direction for determining factors that favor the establishment and spread of noxious weeds, and for designing management practices or prescriptions to reduce the risk of infestation or spread of noxious weeds.

Where funds and other resources do not permit undertaking all desired measures, the agency is to address and schedule noxious weed prevention and control in the following order:

1) First Priority: Prevent the introduction of new invaders;
2) Second Priority: Conduct early treatment of new infestations; and
3) Third Priority: Contain and control established infestations.

Forest Service National Strategy and Implementation Plan for Invasive Species Management

This plan provides direction for taking both short-term and strategic actions.

Short-Term Actions:

- Complete the comprehensive (targeted aquatic and terrestrial invasive species) inventory and mapping for all National Forest land and water, including neighboring areas where appropriate

- Conduct a comprehensive (all invasive species) risk assessment based on existing information for the specific purpose of identifying priority species and areas for program focus
- Focus resources on priority species control in priority areas as identified through risk assessments
- Place specific emphasis on control of invasive plants/noxious weeds and other aquatic and terrestrial invasive species in National Forests and associated areas
- Through research and other means, develop additional tools, such as biological, cultural, chemical, manual, and mechanical controls for priority species; identify mechanisms involved in expansion of NNIP populations
- Monitor long-term invasive species population trends and the effectiveness of treatments.

Strategic Actions:

- Prioritize target species or areas for eradication, control, or containment at national, regional, and local levels, and expand invasive species management activities.
- Create and maintain invasive species inventories and infestation maps.
- Expand technical and financial assistance funding to federal, state, and tribal partners as well as to National Forests and Grasslands for on-the-ground management and control activities.
- Fast-track implementation of cost-effective management solutions for priority invasive species.
- Complete programmatic NEPA analysis; develop standard contract language for treatment of invasive species.

Non-native Invasive Species Framework for Plants and Animals in the Forest Service, Eastern Region

Under this framework, the Eastern Region will work cooperatively with other government entities, partners and tribes to reduce established invasive species populations and limit their spread, to dramatically decrease associated economic and ecologic impacts they cause (USDA Forest Service, 2003b).

In coordination with prevention, Forest Service policy (FSM 2080.1-3, 2080.82-2) is to use Integrated Pest Management for Nonnative Invasive Species (NNIP), including biological, mechanical and chemical methods. Appropriate NEPA analysis is expected for NNIP control.

The Huron-Manistee National Forests 2006 Land and Resource Management Plan

The 2006 Forest Plan specifies Forest-wide Management Area Direction, Goals, Objectives and Desired Future Condition that includes: “Reduce non-native invasive species infestations and prevent new invasive species from becoming established, when possible”; Forest Plan, pg. II-4, Natural Resources (USDA Forest Service (2006b).

Further, Forest-wide Management Area Direction, Standards and Guidelines, section 2000 (Resource Management), pp II-9 to10, prescribes actions that include List, Identify, Prevent, Control and Utilize.

The 2006 Forest Plan states that control of invasive species in Research Natural Areas (RNA) is allowed when the presence of these species threatens the special values of the RNA.

Forest Service Manual 4060 Research Areas and Facilities

Direction on maintaining natural conditions free of invasive species in RNAs is found in Forest Service Manual Section 4063 and in the 2006 Forest Plan. This direction is summarized as follows:

1) 4063.3 - Protection and Management Standards

   To the extent practicable, remove exotic plants or animals. Where pest management activities are prescribed, they shall be as specific as possible against target organisms and induce minimal impact to other components of the ecosystem. The release of biological control organisms for exotic species control should be carefully considered to avoid the introduction of other exotic species.

2) 4063.34 - Vegetation Management

   Use only tried and reliable vegetation management techniques, and then apply them only where the vegetative type would be lost or degraded without management. The criterion is that management practices must provide a closer approximation of the naturally occurring vegetation and the natural processes governing the vegetation than would be possible without management.

   The Station Director, with the concurrence of the Forest Supervisor, may authorize management practices that are necessary for invasive weed control or to preserve the vegetation for which the Research Natural Area RNA was created (FSM 4063.3). These practices may include grazing, control of excessive animal populations, or prescribed burning. Take extra care to protect undisturbed ecological climax conditions, such as old-growth forests.

1.3 PURPOSE AND NEED FOR ACTION

The purpose of this project is to allow the Forest Service to reduce the rate of spread of Non-native Invasive Pest (NNIP) species and to control infestations on priority areas of the Huron-Manistee National Forests (HMNF), including Wilderness, Wild and Scenic Rivers, Research Natural Areas, and recreational trails. It is also the purpose of this project to provide the Huron-Manistee National Forests with the ability to select a course of treatment for NNIP control that is effective, cost efficient, and causes a minimal amount of disturbance.

The Forest Service has a need to achieve rapid control of non-native invasive plant infestations for the protection of natural plant communities and to meet Forest Plan objectives for maintenance of wildlife and Endangered, Threatened and Sensitive species habitats. The resiliency and integrity of natural communities and wildlife habitats are at risk if NNIP infestations remain unchecked. Achieving control of NNIP infestations in priority areas will help prevent the Huron-Manistee National Forests from becoming a source of infestations for surrounding lands, and will slow the spread of invasive plants in portions of northern Lower Michigan.

The current widespread distribution of NNIP infestations on the HMNF threatens the biodiversity of native ecosystems, and negatively alters species composition in areas managed for wildlife habitat across the HMNF. Upland and wetland ecosystems are being impacted negatively by several NNIP species, and are threatened by numerous other non-native species that are likely to become invasive in the near future.

1.4 DECISIONS TO BE MADE

Any decision to take action will focus on control of NNIP infestations consistent with current management direction. A decision on this proposal is limited to determining:

1) Whether to proceed with one of the analyzed Alternatives satisfying the need to take action. This decision involves choosing between the Proposed Action, taking No Action, or one of the alternative courses of action;

2) Which type and/or combination of NNIP control actions, methods, chemicals, and tools to utilize;

3) The maximum number of acres to be treated annually using manual, mechanical, chemical, cultural, and biological control treatments; and

4) Which NNIP species to treat.

The Responsible Official for this decision is the Forest Supervisor. The Forest Supervisor will also decide if a Finding of No Significant Impact can be made or if the preparation of an EIS is necessary.

1.5 PROPOSED ACTION (ALTERNATIVE 2)

This subsection briefly summarizes the Proposed Action (Alternative 2) which is detailed in Chapter 2. The Forest Service proposes a program treating NNIP infestations on the HMNF using an integrated combination of manual, mechanical, cultural, chemical and biological control treatment methods. Treatments under the program would occur annually across the HMNF over the next decade.

Control efforts focus on treating priority habitats, including established and candidate RNAs, Wilderness, Wild and Scenic Rivers and corridors, and areas of special interest. Control efforts are primarily directed toward priority sources of spread: managed wildlife openings, trailheads, parking lots, campgrounds, developed recreation areas, accesses to dispersed recreation areas, and gravel pits. The total acreage of these areas is approximately 40,000 acres. Treatments would typically occur annually across the Forest over the next decade. Treatment of up to 2,000 acres yearly may include any combination of the following methods of control:

1) Manual treatments (such as hand-pulling, hand-cutting, and digging);
2) Mechanical treatments (such as cutting or mowing);
3) Spot treatments with a propane weed torch;
4) Licensed herbicide spot treatments (such as spraying foliage using hand-held or backpack sprayers, hand wicking, cutting woody stems and applying herbicide to the cuts, or injecting herbicide into woody stems);
5) Application of licensed aquatic herbicides;
6) Release of USDA-approved biological control organisms.

The current proposal is intended to allow the use of integrated methods for treatment of invasive plant infestations. Forest staff would determine which NNIP infestations would be treated, and methods to be used, following the treatment protocol set forth in this EA (see the description of the proposed action in Chapter 2). Efforts would be focused on early detection and rapid responses to control small NNIP infestations. Larger infestations would be contained and prioritized for treatment. Management would support the USDA National Strategy and Implementation Plan for Invasive Species Management (USDA Forest Service 2004f).

Management activities would occur annually over the next ten years, including follow-up monitoring to evaluate success of control activities. NNIP control actions could occur across the HMNF wherever priority invasive plant infestations are identified. Some treatment would occur in forested stands, lakes, wetlands and adjacent to rivers and streams. Treatments most typically would occur along roads and trails, in gravel pits, recreational sites, administrative sites, utility corridors, and special use areas.

The Proposed Action does not consider the use of prescribed fire, other than spot-burning with a propane weed torch. Should any NNIP infestation sites be identified in the future where prescribed fire could be an effective treatment method, a separate, site-specific proposal and analysis would be prepared, including public involvement through the NEPA process.

Chapter 2 ISSUES AND ALTERNATIVES

This chapter describes the Proposed Action and reasonable Alternatives for controlling the spread of Non-Native Invasive Plants (NNIP) on the Huron-Manistee National Forests (HMNF). The chapter begins by summarizing results of the public scoping and involvement process that resulted in selection of Alternatives described in this chapter.

2.1 PUBLIC INVOLVEMENT PROCESS

Prior to initiating the formal scoping process, a pre-scoping effort was undertaken to identify preliminary important environmental issues:

- Soil and Water Quality: Potential adverse and beneficial effects from chemical herbicides, manual control, biological control and non-control of NNIP.
- Plant Communities: Potential adverse impacts of NNIP and potential adverse and beneficial effects of proposed control measures related to native plant diversity, ecosystem processes and function (regeneration and sustainability of native plants).
- Aquatic and Terrestrial Animal Habitat: Potential adverse impacts of NNIP and potential adverse and beneficial effects of proposed measures on native animal diversity, including adverse changes to habitat processes and function (effects on fish and aquatic fauna, nesting habitat for birds, forage for terrestrial herbivores, Management Indicator Species, and Endangered, Threatened or Sensitive species).
- Human Health and Safety: Potential adverse or beneficial impacts of proposed NNIP control measures on human health and safety.

Legal notices informing the public about the Proposed Action were published in the Cadillac News on January 27, 2007. A scoping packet explaining the proposal was mailed to 203 interested and affected parties on January 25, 2007. The scoping package provided information and invited the public to submit oral or written comments on the proposal. This scoping package included:

- A statement of the purpose and need for taking action to control NNIP;
- Information on the invasive plants proposed for treatment;
- Specific information on proposed treatment methods; and
- Instructions for submitting comments on the Proposed Action.

Comments received from the public scoping process have been considered and, as appropriate, incorporated into this Programmatic Environmental Assessment (EA). The public scoping process assisted the Forest Service in identifying environmental concerns and issues, and in formulating reasonable alternatives to the Proposed Action.

Information provided in this EA will enable the Responsible Official to make an informed decision regarding the proposal, with an understanding of the potential environmental consequences. The EA also discloses to the public the nature and consequences of the proposal on the environment.

A total of 5 sets of written or oral (telephone) comments were received from the public and environmental specialists. These comments have been used in determining the appropriate scope, and describing and evaluating the Proposed Action and Alternatives investigated in this EA.

2.2 ISSUE IDENTIFICATION

A Forest Service Interdisciplinary Team (IDT) reviewed scoping comments submitted on the Proposed Action. Scoping comments and IDT responses to these comments are located in the project file.

With respect to NEPA, the term issue is a point of environmental discussion, debate, or dispute. As used in this EA, environmental issues are considered to be unresolved conflicts and are used to formulate alternatives for the proposal, prescribe applicable design criteria or conservation procedures, and define environmental effects that need to be evaluated.

Through the scoping process, federal agencies are directed to emphasize those environmental issues relevant to the Proposed Action and deemphasize insignificant issues, narrowing the scope of environmental analysis. In contrast, concerns brought forth by the public, which are not considered issues, are discussed only briefly.

Concerns were identified, and responses to comments were categorized for resolution as follows:

- Addressed through the implementation of site- and project-specific design criteria;
- Resolved through Forest Plan management direction;
- Addressed through the implementation of Best Management Practices (BMPs);
- Addressed through changes in the spatial location of activities in Alternative design;
- Resolved through the development of an Alternative;
- Addressed in the effects analysis of the EA; and
- Concerns identified to be outside the scope of the project.

The results of this review and categorization process are located in the Forest Service project file. Comments that served to drive the development of an Alternative were considered to constitute "unresolved conflicts" with the proposal.

A total of 15 key issues (Table 2-1) were identified from the scoping process. Many of these issues are composite summaries of more than one related public comment.

Table 2-1. Principal Environmental and Socioeconomic Issues.

Issue Number	Issues	Forest Service Resolution
1	There is a need to use broadcast herbicide application using a tractor or 4 wheeler with a boom spray arm in existing meadows or open fields with large infestations of knapweed, hoary alyssum, smooth brome grass, reed canary grass, or sweet clovers, prior to seeding the site to native nectar producing plants for Karner Blue Butterfly habitat. In this specific instance involving KBB habitat, spot treatment with herbicide using a backpack sprayer would not be cost efficient, and may have reduced effectiveness due to the potential for uneven application.	Alternative 4 was developed to allow the use of a boom mounted spray unit on a tractor or ATV. This application method combined with the chosen suite of selective herbicides will provide the additional capability of applying herbicide to larger areas and leaving desirable vegetation. An example would be in the restoration of Karner Blue Butterfly habitat.
2	Loss of nectar-producing plants (most importantly: spotted knapweed, white sweet clover, yellow sweet clover, and purple loosestrife) will harm bee populations and other pollinating insects.	Alternatives 3 and 7 were developed to respond to this issue. Conservation meaures, including planting native nectar producers was added to all alternatives. This issue will be evaluated in the effects section of this EA.
3	Loss of pollinators caused by this action will reduce the ability of beekeepers to pollinate Michigan's fruit crops and cause economic loss to surrounding agriculture.	Alternatives 3 and 7 were developed to respond to this issue. Conservation meaures, including consisting of planting native nectar producers was added to all alternatives. This issue is evaluated in Chapter 4.
4	Proposed use of biological control agents is unnecessary and/or may be harmful to other insects, wildlife, and vegetation.	Forest Service developed Alternatives 3, 5 (no biological controls) and 6 to address this comment

Issue Number	Issues	Forest Service Resolution
5	Some Non-Native Invasive Plant (NNIP) species listed for treatment do not pose substantial harm, or the benefits outweigh the harm, and as such should not be treated under this proposal.	Alternatives 3 and 7 were developed to respond to this issue. Analysis presented in Chapter 4 demonstrates that the spread of NNIP could adversely affect the viewscape, biodiversity, and could adversely affect the sustainability of certain native vegetation, including the food supply of some wildlife. A Cost-Benefit Analysis of key costs and benefits is included in Section 4.8.
6	NNIP nectar-producing plants should be replaced with basswood, milkweed, brambles (raspberries and blackberries) and butterfly weed.	As appropriate, Conservation meaures, including planting native nectar producers has been added to the Alternatives and impact reduction measures are evaluated in Chapter 4.
7	Loss of nitrogen-fixing plants will adversely affect the nitrogen cycle of native communities that may depend on infertile soils; Black Locust and Autumn Olive should be retained to hold and enhance soil conditions as they were planted to do.	Alternatives 3 and 7 were developed to respond to this issue. Potential impacts are addressed in Chapter 4.
8	Removal of Autumn Olive will be harmful to wildlife, as it provides a needed winter food source.	Alternatives 3 and 7 were developed to respond to this issue. This issue is addressed in Chapter 4.
9	Herbicides proposed for use will remain active in the soil and pose environmentally harmful effects.	Alternatives 3 and 6 were developed to respond to this issue. Analysis presented in Chapter 4 indicates that proposed herbicides have low persistence (half-life) and will not pose a substantial environmental or health risk to humans or biota.
10	Removal of Scots pine will be harmful to re-establishment of oak and hardwoods.	Alternatives 3 and 7 were developed to respond to this issue. This issue is addressed in Chapter 4.

Issue Number	Issues	Forest Service Resolution
11	A cost-benefit analysis should be performed to evaluate the overall benefit of eradicating certain NNIP versus the cost of doing so.	A cost-Benefit Analysis of key costs and benefits is included in Section 4.8. The analysis will be performed to a level sufficient to allow the decision-maker to make an informed decision about the advantages and disadvantages of the alternatives.
12	The proposal is too overreaching and/or will be largely ineffective, and therefore needs to be scaled back.	The Forest Service developed Alternatives 3 (reduced acreage of treatment) and 7 to address this comment.
13	The proposal will result in adverse cumulative impacts.	The EA includes an analysis of cumulative impacts for each environmental and socioeconomic resource studied. The analysis concluded that no evidence exists that Alternatives 2, 3, or 4 would result in a substantial cumulative impact to any of these resources.
14	The proposed action should focus on the use of fire and biodiversity to control NNIP.	Alternative 8 was developed to respond to this issue.
15	Based on reference materials and experience, herbicides are often the best option for long-term, large-scale control of certain invasive plants. There are numerous chemicals available, specifically those that more appropriately match a chemical to a target plant species. It is imperative to consider all the ramifications involved with selecting and applying herbicides. The suite of chemicals in Alternative 2 may be too restrictive. Optional herbicides which could enable more flexibility to the Forests include aminopyralid, fluridone, imazapic, imazapyr, and metsulfuron methyl.	Alternative 4 was developed to respond to this issue.

2.3 ALTERNATIVES

Based on results of the public scoping process, the following potential Alternatives were identified and considered in preparing this analysis.

- Alternative 1: No Action (Required by 40 CFR 1501.3) Serves to show the baseline if none of the proposed activities are conducted.
- Alternative 2: Proposed Action -- Biological, chemical, manual, and mechanical treatment (maximum treatment of 2,000 acres per year).
- Alternative 3: Reduced acreage of treatment (maximum treatment of 1,000 acres per year).
- Alternative 4: Add mechanized herbicide application and the option of using five herbicides, including aminopyralid, fluridone, imazapic, imazapyr, and metsulfuron methyl to Alternative 2.
- Alternative 5: Manual, mechanical and chemical, but no biological, controls.
- Alternative 6: Manual, mechanical and biological, but no chemical, controls.
- Alternative 7: Same as the Proposed Action but excludes certain species from the list of non-native species potentially to be treated: autumn olive, black locust, Scots pine, spotted knapweed, purple loosestrife, and white and yellow clovers.
- Alternative 8: Use prescribed burning to control NNIP.

2.3.1 ALTERNATIVES CONSIDERED IN DETAIL

Conservation Measures Common to All Action Alternatives (2,3 and 4) for all Federally-listed Species

Conservation Measures are outlined for each Federally-listed species. Conservation Measures common to all Federally-listed may be summarized as follows:

1) All areas proposed for manual, mechanical or chemical treatment would be reviewed first by Forest Service botanists and wildlife specialists for the possible presence of Federally-listed species prior to implementation of any treatments.
2) If reviews under Measure 1 indicate a need to survey a treatment area for one or more species and sufficiently up-to-date field survey data are not available, then field surveys would be conducted prior to implementation of any manual, mechanical or

chemical treatments using standard professional survey procedures in appropriate seasons. Because field surveys for many species can only be conducted at certain times of the year (e.g., during nesting season for migratory bird species), careful advance planning would be necessary. Surveys would be performed by qualified biologists using standard field survey methodologies appropriate for each Federally-listed species potentially present.

3) Manual, mechanical and chemical treatments would not be conducted in the vicinity of nesting sites or other occurrence sites for sensitive life stages, of any Federally-listed species during seasons when sensitive life stages are typically present. Individual Conservation Measures discussions provide specific details on the types of sites that must be avoided, the times (seasons) those sites must be avoided, and minimum avoidance distances from those sites.

4) Herbicides (chemical treatments) would be applied only by licensed applicators, using manual or vehicle-mounted equipment, at rates and under weather conditions consistent with the manufacturer's label and Forest Service Manual direction (FSM 2150).

5) Only herbicide formulations labeled for use in aquatic habitats would be used in, on or around lakes, ponds, streams, wetlands, shorelines, or riparian areas.

6) Personnel conducting manual, mechanical or chemical treatments would be trained to recognize target NNIP species and instructed to avoid damaging non-target vegetation.

ALTERNATIVE 1 – NO ACTION

Under the No Action Alternative, the Forest Service would not implement an integrated program of treatments to control NNIP infestations on the HMNF.

Limited herbicide, mechanical, manual treatment and biological control of small infestations of NNIP species may occur in special areas or administrative sites through separate decisions, but most NNIP infestations would persist and spread.

ALTERNATIVE 2 – PROPOSED ACTION

Control efforts focus on treating priority habitats, such as established and candidate RNAs, Wilderness, Wild and Scenic Rivers and corridors, and areas of special interest. Control efforts are primarily directed toward sources of spread: managed wildlife openings, trailheads, parking lots, campgrounds, developed recreation areas, accesses to dispersed recreation areas, and gravel pits. Total acreage of these areas is approximately 40,000 acres. Treatments typically would occur annually across the Forest over the next decade. Treatment on up to 2,000 acres yearly may include any combination of the following methods of control:

- Manual treatments (such as hand-pulling, hand-cutting, and digging);
- Mechanical treatments (such as cutting or mowing);
- Spot treatments with a propane weed torch;
- Spot treatments with licensed herbicides (such as spraying foliage using hand-held or backpack sprayers, hand wicking, cutting woody stems and applying herbicide to the cuts, or injecting herbicide into woody stems);
- Application of licensed aquatic herbicides;
- Release of APHIS and USDA-approved biological control organisms.

The current proposal does not consider use of prescribed fire for invasive plant control. Should any sites be identified in the future where prescribed fire may be an effective treatment, a separate, site-specific proposal and analysis would be prepared, including public involvement through the NEPA process.

Additional details of possible treatments under this program, including a discussion of specific herbicides and biological control agents, are described below. Treatment measures would be implemented using protocols listed in Table 2-2. As applicable, site- and project-design criteria listed in Table 2-3 would also be applied in implementing specific treatment measures. Conservation Measures for ETS species and RFSS habitat groups are listed in Table 2-4.

Table 2-2. Treatment Protocols.
1) Category 1, 2 and 3 species listed in Table 1-1 are the usual priority for treatment. For these high-priority species, order of site treatment and methods will be determined by infestation size, location sensitivity, potential for spread, treatment urgency, funding availability and other factors. 2) Category 4 and 5 NNIP sites are considered for treatment when particular infestations are identified to be of resource concern. Examples include infestations at active gravel pits, trailheads, recreation sites, Wilderness areas, RNAs and high-quality natural areas. 3) Manual or mechanical methods shall be the principal method of control for small spot infestations (typically less than 0.1 acre). 4) Herbicide use typically will be considered for infestations sites where manual or mechanical means would be cost-prohibitive, or could result in excessive soil disturbance or other resource damage.

5) The use of biocontrols will be considered for large infestations where eradication would be difficult to achieve due to costs, or where undesirable effects of other control methods are anticipated.

6) Treatment of NNIP infestations on up to 2,000 acres will occur each year.

7) Prior to any treatments, actions covered by this EA will be reviewed by Forest Service staff representing disciplines of aquatics, botany, cultural resources, ecology, fisheries, soils, surface and groundwater, and wildlife biology. Treatments will be designed to minimize effects on associated environmental and human resources. Treatment actions pursuant to this EA will be approved by the District Ranger for corresponding sites and with concurrence from the Michigan State Historic Preservation Office (SHPO), and the USDI Fish and Wildlife Service, as appropriate.

Table 2-3 Project Design Criteria.

1) Notices shall be posted near all areas to be treated, and recently treated, with herbicides.

2) Herbicide application shall occur when wind speeds are less than 10 mph, or according to label direction, to minimize herbicide drift.

3) Herbicide label directions shall be followed carefully. This includes: temporary closure of treatment areas for public health and safety; mixing herbicide solutions in appropriate locations to prevent potential spills in naturally vegetated areas; inspecting spray equipment daily to minimize leakage or misdirection of spray streams; and use of adjuvants and surfactants only as specified by herbicide label direction.

4) Appropriate personal protective equipment shall be worn by licensed herbicide applicators, following label and Forest Service Manual direction.

5) Herbicide containers shall be disposed of following label and Forest Service guidelines.

6) Herbicides shall be labeled and stored appropriately in accordance with label specifications, state and federal laws, and Forest Service Manual and regulations.

7) Herbicides stored on-site shall have Material Safety Data Sheets per Forest

Service guidelines.

8) All those working with herbicides shall review corresponding Material Safety Data Sheets prior to application.

9) Rinse water for cleaning or rinsing actions in conjunction with herbicide treatment shall be disposed of according to Environmental Protection Agency regulations.

10) Weather forecasts shall be obtained prior to herbicide treatment, and treatment activities shall be halted, if needed, to prevent runoff during rain events or wind-drift into non-target areas.

11) Areas to receive herbicide treatment shall be evaluated to ensure protection of Endangered, Threatened, and Sensitive (ETS) species. If any ETS species are found in or near treatment areas, appropriate protective measures shall be implemented, consistent with Recovery Plans and the 2006 Forest Plan.

12) Only formulations approved for aquatic use shall be applied in or adjacent to wetlands, lakes, and streams, as identified from ground-water sensitivity maps, National Wetlands Inventory maps, soils maps and descriptions, and ecological landtype phase (ELTP) information, following label direction (See Table 2-4).*

13) Only least-impacting herbicides registered for such use will be used in wetlands, as determined by Forest wildlife, fisheries, botany and hydrology staff during pre-treatment review.

14) Aquatic herbicide applications require a permit from the Michigan Department of Environmental Quality (DEQ).

15) All affected private landowners, residents, and lake associations of treated lakes shall be notified of plans for local aquatic herbicide application.

16) Specific treatment proposals shall be reviewed by heritage staff professionals, and required documentation and consultation with the Michigan State Historic Preservation Office (MISHPO) and other interested parties completed as necessary, prior to project approval, to ensure full compliance with regulatory provisions.

17) Following NNIP treatments, exposed soils shall be re-vegetated promptly to avoid re-colonization by NNIP. Where manual treatments disturb soil, soil must be tamped down. Use only approved native seed, weed-seed-free mixtures and weed seed-free mulch, per Executive Order 13112, and FSM 2070.3.

18) Retain native vegetation, and limit soil disturbance as much as possible.

19) Fueling or oiling of mechanical equipment shall be conducted away from aquatic habitats.

20) Equipment, boots, and clothing shall be cleaned thoroughly before moving onto or from treatment sites, to ensure that seeds or other propagules of invasive species are not transported onto the site, or to other sites.

21) NNIP parts capable of starting new plants (seeds, rhizomes, cuttings, etc.) shall be disposed of in a way that will not facilitate spread.

22) All control treatments shall be timed to be most effective, based on invasive species phenology and life history.

23) Application and use of herbicides or pesticides is prohibited in and adjacent to occupied Karner blue butterfly habitat between April 1 and August 15, except when the wind is not blowing toward the habitat and a minimum buffer of 100 feet (30 m) exists between the habitat and the treatment area. Avoid impacting wild lupine during application.

24) All herbicide applicators shall meet minimum State and Forest Service herbicide certification and licensing requirements, or be under direct field supervision of a certified herbicide applicator. All applicators shall be trained in the appropriate and safe use of herbicides.

25) Personnel performing any treatments shall be trained to recognize target NNIP species, and exercise care to avoid treating any plant that cannot be positively identified as a target NNIP species.

26) Vehicles will utilize only open existing paved and unpaved roads. Vehicles shall not use Forest Roads at times of surface inundation or saturation.

27) Manual, mechanical and chemical treatment activities in wetlands shall be limited to activities that do not require vehicular entry onto surface soils.

28) . Individual NNIP tree or shrub specimens could be treated at any time, providing inspection shows no nesting bird in or below the targeted tree/shrub. Known nests or dens of Endangered, Threatened, or Sensitive species will be protected from disturbance during their breeding season.

Table 2-4. Conservation Measures from Biological Evaluation of the Huron-Manistee National Forests' Non-native Invasive Plant Control Project, 2008.

ETS Species or Habitat Group	Focal Species or RFSS Plant Species	Conservation Measure
ETS Species		
Indiana bat		Planned treatments shall be reviewed by Forest Service biologists prior to implementation. Treatment areas shall be visually inspected for favorable Indiana bat maternity habitat prior to initiating any treatments between May 1 and August 31. Should treatments be proposed during that time period in areas where Indiana bat habitats are found to occur, they shall be conducted in a way that minimizes physical or chemical contact with Indiana bats or their prey, following Forest Plan Forest-wide Standards and Guidelines. Manual, mechanical, or chemical NNIP plant control activities will not be performed within five miles of known Indiana bat winter hibernacula between May 1 and June 15, or September 1 through October 20, or within five miles of summer hibernacula between May 1 and August 31.
Kirtland's warbler		Kirtland's warblers are migratory, occupying habitats on HMNF only during summer breeding season. As noted above, nesting does not usually begin until after May 1, and young typically fledge before mid August. Limiting manual, mechanical and chemical treatment activities in designated Kirtland's warbler Essential Habitat to times outside the main breeding season between May 1 and August 15 should effectively avoid disruptions to nesting activities. Human entry into occupied habitat and treatments within ¼ mile of occupied habitat are prohibited between May 1 and August 15. Late August and September would provide a window of opportunity to conduct manual, mechanical and chemical treatments while most NNIP species remain foliated and actively growing. Early season NNIP species such as garlic mustard that are generally senescent, and hence unresponsive to herbicides, by August could be effectively treated in late April. Manual sawing and grubbing of woody NNIP species such as buckthorns and honeysuckles shall also be performed before May 1 or after August 15.
Great Lakes piping plover		Great Lakes piping plovers are migratory, occupying habitats on HMNF only during summer breeding season. As noted above, nesting does not usually begin until after May 1, and young typically fledge before mid August. Limiting manual, mechanical and chemical treatment activities on sandy beaches and adjoining foredunes to times outside the main breeding season should effectively avoid disruptions to nesting activities. All work shall be performed in compliance with the Recovery Plan and Forest Plan, which prohibit treatments within occupied nesting areas, or in potential habitat, during nesting season, April 1 to August 31. September would provide a window of opportunity to conduct manual, mechanical and chemical treatments while most NNIP species remain foliated and actively growing. Specifically, manual, mechanical and chemical treatments shall be avoided between April 1 to August 31 in Nordhouse Dunes and Lake Michigan Recreation Area CHU on the MNF.

ETS Species or Habitat Group	Focal Species or RFSS Plant Species	Conservation Measure
Karner blue butterfly		This proposal does not include any herbicide treatment within occupied KBB habitat and does not include any treatment in or adjacent to occupied KBB habitat between March 15 and August 15. . Because life stages of Karner Blue Butterfly (KBB) sensitive to physical trampling or chemical spray streams are present in inhabited areas throughout the year, no window of opportunity to conduct manual, mechanical or chemical treatments exists, that does not risk inadvertent adverse effects. Care to minimize trampling of wild lupine and other vegetation adjoining wild lupine, as well as to minimize spray drift, when working within KBB Management Units (MUs) is essential. The Forest Plan and Karner Blue Recovery Plan prohibit treatments in KBB MUs April 1 through August 15, when they could damage or reduce wild lupine.
Pitcher's thistle		Conservation Measures shall consist of following Forest-wide Standards and Guidelines (USDA Forest Service 2006b, II-29) to minimize trampling of vegetation, as well as minimizing spray drift, when working near sand dunes. Individual Pitcher's thistle plants shall be marked and protected prior to chemical control treatments.
Aquatic Habitat Group		
Large Rivers	Lake Sturgeon	Only herbicide formulations labeled for aquatic use would be applied in, on or around riparian areas, wetlands, or along shorelines. Herbicides shall only be applied by licensed herbicide applicators trained to handle and use pesticides in an environmentally responsible manner, following Forest Service Manual direction (FSM 2150) and manufacturers' label requirements.
Medium to Large Streams	Channel darter	
Clear, Cool Headwaters of River Systems	Creek heelsplitter	
Clear Vegetated Lakes and Vegetated Pools and Runs of Creeks and Rivers	Pugnose Shiner	
RFSS plant species		
Plants, By Habitat		
Sub-Irrigated Moist Forest and Thicket	Lily-leaved twayblade	Areas of sub-irrigated moist forest and thicket subject to manual, mechanical or chemical treatments shall be surveyed for lily-leaved twayblade prior to initiation of work. Personnel performing any treatments shall be trained to recognize target NNIP species, and exercise care not to injure any plant that cannot be positively identified as a target species.

ETS Species or Habitat Group	**Focal Species or RFSS Plant Species**	**Conservation Measure**
Clay-Loam Forest and Rich Mesic Hardwood Forest	Goldie's wood fern, Orange-tinged fringe lichen, American ginseng	Areas of clay-loam forest and rich mesic hardwood forest subject to manual, mechanical or chemical treatments shall be surveyed for the presence of species (listed in Section 5.2.2.2, page 60 of the Biological Evaluation) prior to initiation of work. Personnel performing treatments shall be trained to recognize target NNIP species, and exercise care not to injure any plant that cannot be positively identified as a target species.
Forest with Needle Duff Habitat	Pine-drops	Areas of forest with needle duff subject to manual, mechanical or chemical treatments shall be surveyed for pine-drops prior to initiation of work. Personnel performing any treatments shall be trained to recognize target NNIP species and exercise care not to injure any plant that cannot be positively identified as a target species.
Hardwood Forest Openings	Ternate grape fern	Areas of hardwood forest openings subject to manual, mechanical or chemical treatments shall be surveyed for ternate grape fern prior to initiation of work. Personnel performing any treatments shall be trained to recognize target NNIP species and exercise care not to injure any plant that cannot be positively identified as a target species.
Semi-open Mesic Depressions	Northern wild comfrey	Areas of semi-open mesic depressions subject to manual, mechanical or chemical treatments shall be surveyed for northern wild comfrey prior to initiation of work. Personnel performing treatments shall be trained to recognize target NNIP species and exercise care not to injure any plant that cannot be identified positively as a target species.
Barrens	Pale agoseris, Missouri rock cress, Purple milkweed, American chestnut, Hill's thistle, Ram's head lady-slipper, Upland boneset, Rough fescue, False boneset, Alleghany plum, Hairy mountain mint, Forked bluecurls, Bastard pennyroyal, Purple sand grass	Barrens areas subject to manual, mechanical or chemical treatments shall be surveyed for RFSS plants listed above prior to initiation of work. Personnel performing any treatments shall be trained to recognize target NNIP species and exercise care not to injure any plant that cannot be positively identified as a target species.
Great Lakes Barrens, Open Dunes, Wooded Dunes, Wooded Dune Swales, and Interdunal Wetlands	Ram's head lady-slipper, False violet, Northern fir-moss, Northern appressed clubmoss, Fascicled broomrape, Meadow-beauty, Toothcup, Lake Huron	Great Lakes coastal areas subject to manual, mechanical or chemical treatments shall be surveyed for RFSS plants listed above, prior to initiation of work. Personnel performing any treatments shall be trained to recognize target NNIP species and exercise care not to injure any plant that cannot be positively identified as a target species.

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ETS Species or Habitat Group	**Focal Species or RFSS Plant Species**	**Conservation Measure**
Dry Sand Prairie	Western silvery aster, Side-oats gramma, Hill's thistle, False boneset, Leggett's pinweed, Furrowed flax, Bastard pennyroyal, Western silvery aster	Personnel performing any treatments shall be trained to recognize target NNIP species and exercise care not to treat any plant that cannot be positively identified as a target species. Vehicles will utilize existing paved and unpaved roads. Vehicles entering dry sandy areas will use caution on dry sandy soils from manual or mechanical damage caused by mowers or other treatment vehicles. Minimizing the potential for wildfire will require limiting use of the weed torch to periods when fire risk is lowest, such as early spring or following heavy rainfall. Fire management experts on the HMNF staff would be consulted prior to use of the weed torch or any other action involving fire.
Open Dry Sand	Hill's thistle, Yellow tongue cladonia, Leggett's pinweed, Furrowed flax, Alleghany plum, False pennyroyal, Bastard pennyroyal, Purple sand grass	
Mesic Sand Prairie and Northern Wet-Mesic Prairie	Purple milkweed, Canada milkvetch, False boneset, Toothcup, Prairie dropseed	Vehicles shall not enter areas at times of surface inundation or saturation. Personnel performing any treatments shall be trained to recognize target NNIP species and exercise care not to treat any plant that cannot be positively identified as a target species.
Wet-Mesic Prairie and Meadow	Purple spike rush, Small-headed rush, Vasey's rush, Cross-leaved milkwort, Meadow beauty, Toothcup, Few-flowered nut-rush, Tall nut-rush, Atlantic blue-eyed grass, Yellow ladies'-tresses, Prairie dropseed, New England Violet	
Riparian - Forested (includes Southern Floodplain Forest)	False hop sedge, Schweinitz's sedge, Eastern candlewax lichen, Orange-tinted fringe lichen, Butternut, White adder's-mouth, Virginia bluebells, Bog blue grass, New England violet	Vehicles shall use existing forest roads. Vehicles shall not use Forest Roads at times of surface inundation or saturation. Personnel performing any treatments shall be trained to recognize target NNIP species and exercise care not to treat any plant that cannot be positively identified as a target species.
Riparian – Non-Forested	Canada milkvetch	

ETS Species or Habitat Group	Focal Species or RFSS Plant Species	Conservation Measure
Swamp and Hardwood Conifer Swamp (includes Southern Swamp)	Ram's head lady-slipper, False-violet, White adder's-mouth, Bog blue grass	Manual, mechanical and chemical treatment activities could include activities that do not require vehicular entry onto surface soils. Broad, non-selective treatment actions capable of killing substantial numbers of non-target plants or of severely damaging swamp soils, will not be conducted in swamps. Personnel performing any treatments shall be trained to recognize the target species and exercise care not to treat any plant that cannot be positively identified as a target species.
Sub-irrigated Forest	Blunt-lobed grapefern, False-violet, Lily-leaved twayblade	
Coastal Plain Marsh and Intermittent Wetland	Purple spike rush, Engleman's spike-rush, Three-ribbed spike rush, Umbrella grass, Orange grass, Small-headed rush, Vasey's rush, Leggett's pinweed, Northern appressed clubmoss, Cross-leaved milkwort, Waterthread pondweed, Bald rush, Whorled mountain mint, Meadow beauty, Toothcup, Hall's bulrush, Few-flowered nut-rush, Tall nut-rush, Atlantic blue-eyed grass	

ETS Species or Habitat Group	Focal Species or RFSS Plant Species	Conservation Measure
Wet, Exposed Mineral Soils	Engleman's spike-rush, Northern fir-moss, Orange grass, Small-headed rush, Vasey's rush, Northern appressed clubmoss, Meadow beauty	Manual, mechanical and chemical treatment activities could include activities that do not require vehicular entry onto surface soils and prevent substantial sedimentation of water by treatment of riparian areas. Broad, non-selective treatment actions, such as mowing, capable of killing substantial numbers of non-target plants or of severely damaging wet soils, will not be conducted on wet, exposed mineral soils. Personnel performing any treatments shall be trained to recognize the target species and exercise care not to treat any plant that cannot be positively identified as a target species.
Aquatic Pond and Lake	Waterthread pondweed	
Marsh	Torrey's bulrush	
Localized Wet Depressions - Swales in Oak, Swales in Pine, and Vernal Pools	False hop sedge, Engleman's spike-rush, Three-ribbed spike-rush, Small headed rush, Vasey's rush, Bog bluegrass, Prairie dropseed	
Lake Shorelines (Acid Shoreline, Calcareous Shoreline, and Neutral Shoreline)	Canada milkvetch, Umbrella grass, Northern fir-moss, Small-headed rush, Vasey's rush, Leggett's pinweed, Northern appressed clubmoss, Cross-leaved milkwort, Bald rush, Whorled mountain mint, Toothcup, Torrey's bulrush, Few-flowered rush, Tall nut-rush, Atlantic blue-eyed grass, Lake Huron tansy, New England violet	
Cedar Swamps	Eastern candlewax lichen, Ram's head lady-slipper, White adder's-mouth	Manual, mechanical and chemical treatment activities could include activities that do not require vehicular entry onto surface soils. Personnel performing any treatments shall be trained to recognize the target species and exercise care not to treat any plant that cannot be positively identified as a target species.

ETS Species or Habitat Group	Focal Species or RFSS Plant Species	Conservation Measure
Terrestrial Fauna Habitats		
Beaches and Dunes	Piping Plover	Limit manual, mechanical and chemical treatment activities on sandy beaches and adjoining foredunes to times outside of the breeding season between April 1 and August 31. September would provide a window of opportunity to conduct manual, mechanical and chemical treatments while most NNIP species remain foliated and actively growing. Manual, mechanical and chemical treatments shall be avoided between April 1 to August 31 in Nordhouse Dunes and Lake Michigan Recreation Area CHU on the MNF.
River/Streams	Wood Turtle	Manual, mechanical and chemical treatments shall not be conducted during the peak wood turtle nesting month of June in areas of suitable shoreline habitat in areas of the HMNF where wood turtles are known to occur. These areas include the Au Sable River, Wakeley Lake, Vaughn Lake, Pine River, and Tuttle Marsh (and associated tributaries) on the HNF; and the Pine River, Little Manistee River, Big Sable River, Pere Marquette River, Baldwin River, White River, and Muskegon River (and associated tributaries) on the MNF. If manual, mechanical or chemical treatments are conducted in these areas during the nesting season, areas proposed for treatment shall first be surveyed for wood turtles and spotted turtles. These measures would reduce the risk of inadvertent trampling or chemical exposure of sensitive eggs and young.
Ponds and Lakes (Larger)	Bald Eagle	Because of potential nest disturbance and/or abandonment due to noise generation and human presence, no manual, mechanical or chemical NNIP control treatments shall be conducted within the Primary Nest Zone or Secondary Zones defined by the BEMP (660 feet of a bald eagle nest) between February 1 and July 15. Noise-generating equipment such as vehicles, mowers, chain saws, string trimmers, or weed torches shall not be operated within Primary Nest, Secondary, or Tertiary Zones defined by the BEMP (within ½ mile of a bald eagle nest) during this period.
Ponds and Lakes (Smaller)	Blanding’s Turtle	Ponds scheduled for treatment during the Blanding’s turtle nesting season (April to November) shall first be surveyed for nesting sites. If nesting sites are found, treatments shall be delayed until after nesting is complete.
Marshes	American Bittern, Northern Harrier	Manual, mechanical and chemical treatments shall not be conducted during the nesting seasons for northern harrier (April 15 to July 15) or American bittern (May 1 to July 31) in marshes where the species nest. Marshes scheduled for treatment during the nesting season shall be surveyed for nesting sites.

ETS Species or Habitat Group	Focal Species or RFSS Plant Species	Conservation Measure
Bogs and Fens	Spotted Turtle	Bogs and fens scheduled for treatment during spotted turtle nesting season (April to November) shall first be surveyed for spotted turtles and treatment delayed until turtles have vacated the area. Vehicles will approach bogs and fens only on established roadways.
Shrub/Scrub Wetlands	Golden-winged Warbler	Manual, mechanical and chemical treatments shall not be conducted during the nesting season (May 15 to July 15) within 660 feet of known golden-winged warbler nesting sites. Treated areas shall be surveyed for nests if work must be performed in scrub-shrub habitats during the golden-winged warbler nesting season. Vehicles carrying workers and equipment will approach the shorelines only on established roadways. Workers will walk to wetland treatment areas using existing trails or across uplands to the extent possible.
Riparian/Lowland Hardwoods/Floodplain (Mid - Late)	Cerulean Warbler	Manual, mechanical and chemical treatments shall not be conducted during the nesting season (May 15 to July 15 for cerulean warbler and March 15 to July 15 for red-shouldered hawk) in riparian forest areas where the species nest. Riparian forest areas scheduled for treatment during the nesting season shall be surveyed for red-shouldered hawk or cerulean warbler activity.
Riparian/Lowland Hardwoods/Floodplain (Early-Mid)	Eastern Massasauga	Manual, mechanical and chemical treatments in MMUs shall be conducted in late fall, winter, or early spring (i.e., November through early March) when eastern massasaugas typically hibernate. It is especially important to avoid conducting manual, mechanical or chemical treatments in MMUs during late spring or early summer, when young may be present. If manual, mechanical, or chemcial NNIP control treatments must be conducted in MMUs outside the hibernation season (November through early March), treatment areas should first be surveyed for the presence of massasauga nests, eggs, or young.
Lowland Conifer/Boreal (Mid-Late)	Black-backed Woodpecker	Manual, mechanical and chemical treatments shall not be conducted during the nesting season (May 15 to June 30) in the immediate vicinity of known black-backed woodpecker nesting sites. Areas of Lowland Conifer habitat with multiple dead canopy trees shall be surveyed for evidence of woodpecker activity if work must be performed in black-backed woodpecker nesting season.
Oak/Pine (Late)	Red-headed Woodpecker	Manual, mechanical and chemical treatments shall not be conducted during the nesting season (May 15 and August 31) in the immediate vicinity of known red-headed woodpecker nesting sites. Areas of late successional Oak/Pine habitat with multiple dead canopy trees shall be surveyed for nests if work must be performed in the red-headed woodpecker nesting season.

ETS Species or Habitat Group	Focal Species or RFSS Plant Species	Conservation Measure
Oak/Pine (Early - Mid)	Sprague's Pygarctic	Manual, mechanical and chemical treatments shall be excluded from areas of flowering spurge, the larval host plant for Sprague's pygartic. Manual, mechanical or chemical NNIP control treatments should be avoided in areas of early successional oak/pine habitat during whip-poor-will nesting season, which generally includes June and July. If manual, mechanical or chemical treatment must be performed in such habitat during June or July, treatment areas should first be surveyed for (usually cryptic) whip-poor-will nests. No work should be performed in the immediate vicinity of discovered whip-poor-will nesting sites during June or July.
Mixed Hardwoods (Late)	Northern Goshawk	Manual, mechanical and chemical treatments shall not be conducted during the nesting season (April 15 to July 15 for northern goshawk and May 15 to August 15 for wood thrush) in hardwood forest areas where the species nest. Hardwood forest areas scheduled for treatment during the nesting season shall first be surveyed for nesting sites.
Aspen/Birch (Early)	Golden-winged Warbler	Manual, mechanical and chemical treatments shall not be conducted during the nesting season (May 15 to July 15) within 660 feet of known golden-winged warbler nesting sites. Manual, mechanical or chemical NNIP control treatments should be avoided in areas of early successional Aspen/Birch habitat during whip-poor-will nesting season, generally June and July. If manual, mechanical or chemical treatment must be performed in such habitat during June or July, treatment areas should first be surveyed for (usually cryptic) whip-poor-will nests. No work should be performed in the immediate vicinity of discovered nesting sites during June or July.
Red Pine/White Pine/Spruce	American Marten	Manual, mechanical and chemical treatments shall not be conducted in areas of marten activity during the denning or breeding seasons (March 1 to August 31). For Sprague's pygarctic or dusted skipper, pre-treatment surveys in areas of forested dominated by red pine, white pine, and spruce should be conducted using blacklighting between the third week in June and the fourth week in August.

ETS Species or Habitat Group	Focal Species or RFSS Plant Species	Conservation Measure
Jack Pine (Early - Open)	Michigan bog grasshopper	Work in areas dominated by leatherleaf or young stands of tamarack or jack pine shall be performed in July or August when the risk for trampling or spraying less mobile or more delicate life stages such as eggs or larvae is lower. If work in those areas must be performed at other times of the year, the areas shall be surveyed for Michigan bog grasshopper prior to initiating treatment. Because of the difficulty in spotting the smaller eggs and larvae, surveys shall be conducted during August or September when more readily observed adults are likely to be present. No manual, mechanical, or chemcial NNIP control treatments can be conducted from the beginning of September through the end of June in areas of vegetation dominated by leatherleaf, young stands of tamarack or jack pine without first surveying those areas for Michigan bog grasshopper. Surveys must be conducted in July or August when the more readily visible adult life stage is present.
Jack Pine (Mid-Successional)	Kirtland's Warbler	Limiting manual, mechanical and chemical treatment activities in designated Kirtland's warbler management areas and other jack pine stands to times outside of the main breeding season between May 1 and August 15 should effectively avoid disruptions to nesting activities. Late August and September would provide a window of opportunity to conduct manual, mechanical and chemical treatments while most NNIP species remain foliated and actively growing. Early season NNIP species such as garlic mustard that are generally senescent, and hence unresponsive to herbicides, by August could be treated effectively in late April. Manual sawing and grubbing of woody NNIP species such as buckthorns and honeysuckles shall also be performed before May 1 or after August 15. Manual, mechanical or chemical NNIP control treatments should be avoided in areas of mid-successional jack Pine habitat during whip-poor-will nesting season, generally including June and July. If manual, mechanical or chemical treatment must be performed in such habitat during June or July, treatment areas should first be surveyed for (usually cryptic) whip-poor-will nests. No work should be performed within 660 feet of discovered nesting sites during June or July.
Jack Pine (Mid-Late Successional)	Spruce Grouse	Manual, mechanical and chemical treatments should not be conducted during the nesting season (May 1 to July 31) within 660 feet of known spruce grouse nesting sites. Proposed NNIP treatment areas in mid- to late-successional jack pine forest habitat must be surveyed for spruce grouse nests prior to initiating treatments during the nesting season. For imperial moth, Sprague's pygarctic, or dusted skipper treatment areas in mid- to late-successional

		forests dominated by jack pine should be surveyed using blacklighting between the third week in June and the fourth week in August.
ETS Species or Habitat Group	**Focal Species or RFSS Plant Species**	**Conservation Measure**
Pine Barrens	Dusted Skipper	Areas of bluestem grasses shall be surveyed for dusted skipper prior to initiating manual, mechanical or chemical treatments. The MNFI recommends surveys be conducted sometime between the fourth week in May and the fourth week in June when more visible adults are in flight (MNFI, 2007). If manual, mechanical or chemical treatments must be performed in areas where Dusted skipper is known to occur, treatments shall be performed in late May through mid June when the predominant life stage is the more mobile adult rather than one of the less mobile, more vulnerable life stages. Areas of pine barrens vegetation should be surveyed for dusted skipper prior to initiating manual, mechanical or chemical treatments.
Savanna (Oak-Pine Barrens)	Red-headed Woodpecker	No manual, mechanical, or chemcial NNIP control treatments can be conducted during the nesting season (May 15 and August 31) within 660 feet of known red-headed woodpecker nesting sites. Proposed treatment areas containing clusters of multiple dead canopy trees must be surveyed for red-headed woodpecker nests prior to initiating treatments.
Grassland (Large Openlands)	Henslow's Sparrow	Manual, mechanical and chemical treatments shall not be conducted during the nesting season (May 15 to July 31) within 660 feet of Henslow's sparrow nesting sites. Grassland treated areas shall be surveyed for nests if work must be performed in grassland habitats during the nesting season of either species. Surveys for other large grassland opening RFSS would have to be individually tailored. If nests are found, areas within 660 feet of the nests should not be treated during the nesting season.
Grassland (Smaller Openlands)	Eastern Box Turtle	Manual, mechanical and chemical treatments shall not be conducted in grassland openings within forested areas during the nesting season (between the first week in June and the third week in July). If such areas must be treated during that time, they shall be surveyed for the presence of eastern box turtles. The timing of surveys for other small grassland opening RFSS would have to be individually tailored.
Dry Prairie (Large)	Sharp-tailed Grouse	Treatment areas in naturally vegetated upland grassland habitats shall be surveyed for sharp-tailed grouse nesting activity prior to any manual, mechanical or chemical treatment during the nesting season (conservatively estimated to extend from May 15 to July 31). No manual, mechanical or chemical treatments shall be conducted within 660 feet of spruce grouse nesting sites during the nesting season.

ETS Species or Habitat Group	Focal Species or RFSS Plant Species	Conservation Measure
Dry Prairie (Large or Smaller)	Ottoe Skipper	Areas of dry prairie shall be surveyed for ottoe skipper prior to initiating manual, mechanical or chemical treatments sometime between the third week in June and the third week in August when the more visible adults are in flight (MNFI, 2007). If manual, mechanical or chemical treatments must be performed in areas where ottoe skipper is known to occur. Treatments shall be performed in late May through mid June when the predominant life stage is the more mobile adult rather than one of the less mobile, more vulnerable life stages. If treatments are necessary in areas found to contain ottoe skippers, they should be performed in spring prior to June 15. The timing of surveys for the other RFSS of dry prairies would have to be individually tailored.

The Forest Services acknowledges that new information will likely be published over the course of the proposed 10-year program with information on new herbicides and biological control agents, as well as new information on the herbicides and biological control agents already included in the program. Based on new published data, the Forest Service might consider the addition of new herbicides and/or biological control agents to the program. However, the Forest Service would conduct a revised evaluation before using any herbicide or biological control agent other than those specifically indicated in these alternatives. The Forest Service would also consider the elimination of certain herbicides and/or biological control agents if new published data indicates previously undiscovered environmental risks.

The following Conservation Measures are designed for the protection, restoration, and maintenance of Karner blue butterfly as they apply to occupied and unoccupied habitat. These are from the Programmatic Biological Assessment for the Huron-Manistee National Forest (USDA 2003), the Final Recovery Plan for the Karner blue butterfly (*Lycaeides melissa samuelis*) (USFWS 2003), and the Forest Plan for the Huron-Manistee National Forests (Forest Plan 2006, pp. II-26 - 29).

This project proposes no herbicide treatments within occupied KBB habitat and no manual or mechanical treatment activities within occupied KBB habitat between March 15 and August 15.

Karner Blue Butterfly Conservation Measures	Occupied Habitat	Unoccupied Habitat
Implement The Karner Blue Butterfly Recovery Plan (USFWS 2003).	√	√
Trail Management, Vehicle and ORV Traffic, and Camping and Recreation		
Road construction, trail construction, and vegetation management activities will be designed to protect and improve potential Karner blue butterfly habitat.	√	√
Roads and trails will be managed and maintained in a manner to protect or maintain areas with wild lupine. Where this is not feasible and damage is occurring, trails and roads may be relocated or decommissioned.	√	√
Maintenance and use of existing roads and trails will be managed in a manner to protect or maintain occupied habitat and areas with wild lupine. Where this is not feasible and damage is occurring, trails and roads will be relocated or decommissioned.	√	√
Prohibit ORV use with woodland strips or brush piles along trails and roads.	√	
Direct camping to areas outside occupied habitat. Where posted, camping will be prohibited in occupied sites.	√	
Barricade or block access to managed Karner blue butterfly	√	√

Karner Blue Butterfly Conservation Measures	Occupied Habitat	Unoccupied Habitat
habitat to eliminate off-road vehicle use when noted using a variety of methods such as woven-wire fencing, wind-rowed slash, rocks, stumps, barrier posts, or cross bucks. Passage for wildlife and permitted recreational users will be provided regardless of the method used. A closure order should be written to facilitate enforcement of this protection measure.		
Development		
Oil and gas development will contain a "no surface occupancy" stipulation and will exclude road building.	√	
Habitat Management and Protection		
Conduct annual surveys of proposed treatment units to determine presence/absence of the Karner blue butterfly. These will serve as pre-activity surveys. If the species is found, the Huron-Manistee National Forests will follow the Conservation Measures for occupied habitat.	√	√
Conduct annual pre- and post-treatment monitoring of habitat conditions (i.e., wild lupine cover, cover of other Karner blue butterfly nectar plants, savanna plant species presence, presence of non-native invasive species, canopy cover) and occurrence or abundance of Karner blue butterflies at selected treatment sites to determine treatment effectiveness and whether measures of restoration success have been accomplished.	√	√
Monitor activities at the project level.	√	√
Maintain or restore Karner blue butterfly habitat using prescribed burning, timber harvest, manual or mechanical vegetation removal, chemical vegetation removal, soil scarification, and seeding/planting methods as outlined in the Forest Plan, Chapter II, and the Final Recovery Plan for the Karner Blue Butterfly, Appendix G.	√	√
Within treatment units managed for Karner blue butterfly, provide savanna-like conditions with an average of 25-50% crown closure and openings with an abundance of wild lupine and other Karner blue butterfly first and second flight nectar plant species.	√	√
Within treatment units managed for Karner blue butterfly, maintain savanna-like conditions by removing woody encroachment and promoting the growth of savanna plant species.	√	√
Within treatment units managed for Karner blue butterfly, provide dispersal corridors in order to facilitate dispersal	√	√

Karner Blue Butterfly Conservation Measures	Occupied Habitat	Unoccupied Habitat
between suitable habitat sites in occupied and unoccupied areas.		
The application and use of herbicides or pesticides is prohibited in and adjacent to occupied Karner blue butterfly habitat between April 1 and August 15, except when the wind is not blowing toward the habitat and there is a minimum buffer of 100 feet (30 m) between the habitat and the treatment area. Avoid wild lupine during application.	√	
Cutting of trees is prohibited between March 15 and August 15 in occupied sites. Cutting is restricted to a four-year frequency. Allow cutting of trees that pose a safety hazard.	√	
Cutting trees with non-mechanized equipment such as chainsaws is preferred in occupied sites. Other mechanized tree cutting equipment may be allowed by exception. If possible, mechanical and hand pruning of shrubs and trees should be done under frozen ground conditions.	√	
Pile slash not to exceed 20 percent of an occupied site, burning slash piles during the winter and avoiding piling slash in areas containing concentrations of wild lupine.	√	
Locate logging roads, skid trails, and log yards to avoid or minimize impact to occupied sites. Where possible, place landings ≥ 200 m from historically or recently occupied sites.	√	
Mowing and/or brush hogging activities are prohibited between March 15 and August 15 and on a four-year frequency in occupied sites. If possible, mow after August 31 under frozen ground conditions with the mower blade set at 6-8 inches above the ground.	√	
When mowing in occupied sites, divide areas into at least 2 units, each of which supports lupine and nectar sources. At least one unit will remain untreated each season unless there is a colonization source within ¼ mile that has the capability to re-colonize the area. Leave cut vegetation on site that may contain eggs, unless the cut vegetation is collected and placed in another suitable habitat site.	√	
When conducting prescribed burns in occupied sites, divide sites into at least three burn units based on numbers of butterflies and burn no more than 1/3 of a site in any one year. If there are less than 10 individual butterflies during the first flight survey, then the entire site can be burned. Create firelines between areas to be burned and unburned to protect against wildfire or other chance events. When	√	

Karner Blue Butterfly Conservation Measures	Occupied Habitat	Unoccupied Habitat
possible, minimize soil disturbance when constructing firelines by using rotovated or disked breaks.		
Keep unburned occupied patches within ¼ mile (0.5 km) of burned occupied sites to aid re-colonization.	√	
Use patchy burns. Design burn areas with irregular shapes and small-scale unburned vegetation-skips.	√	
In occupied sites, use an approximate four-year burning frequency.	√	
Site scarification is prohibited within occupied sites between March 15 and August 15 and on a four-year frequency. Expose mineral soil to aid seeding of native nectar plants. Leave 25 to 50 percent of an occupied site undisturbed. Protect concentrations of wild lupine or other nectar plants.	√	
Propagate wild lupine, nectar plants, and savanna plant species by using seeds with a locally-based genotype when possible. If collected from the site, limit the collection to no more than 25 percent of available seeds and collect after July 1.	√	√
Apply treatments to no more than 1/3 of any particular occupied habitat patch within a calendar year. Treatment will be conducted first on the most degraded third of a patch. This approach will reduce take of Karner blue butterfly and facilitate re-colonization of recently treated portions.	√	
Treatment of more than 1/3 of any particular occupied habitat patch within a calendar year may be conducted when: Treatment of a larger area is necessary to prevent the spread of invasive species and disease outbreaks which threaten the viability of Karner blue butterfly. A large viable Karner blue butterfly metapopulation is identified, expanding the focus for treatment from the level of individual habitat patches to the level of the metapopulation complex as a whole. An occupied habitat patch is less than 1 hectare. A patch this size may be treated in its entirety within a single calendar year if a suitably connected source population exists within 1 kilometer. Experimental management techniques require testing.	√	
Avoid spreading seeds of weedy exotic plants via equipment. Monitor for invasion of aggressive exotic	√	√

Karner Blue Butterfly Conservation Measures	Occupied Habitat	Unoccupied Habitat
plants and remove them.		
Activities will be scheduled and completed when they are least likely to impact any life stage of the butterfly.	√	
Watershed management activities that are incompatible with Karner blue butterfly will be excluded.	√	
Monitoring for Karner blue butterfly and habitat including: - Annual sampling each of the Brohman Metapopulation Area during the first or second flight period to determine population size. Preference should be given to the second flight period because this is when the greatest number of butterflies would be present. - Determining and tracking the amount and condition of habitat maintained and restored annually. - Identifying threats and disturbance factors affecting the Brohman Metapopulation Area and habitat a minimum of every three years. - Assessing the connectivity of subpopulations every three years to confirm that subpopulations remain connected.	√	
Implement recovery measures: inventories, management plans, information and education, restoration, and studies as appropriate.	√	

Proposed Manual and Mechanical Methods

Manual or mechanical methods would be the principal methods of control for small spot infestations. Examples of hand tools that might be used include shovels, saws, axes, loppers, hoes, or weed-wrenches. Mechanical methods may include cutting with a string trimmer, chain saw, brush saw, aquatic harvester, or mower. Plowing or disking may be used in gravel pits or other heavily disturbed sites. Barriers such as black plastic or lake-bottom screens may be used to prevent growth of herbaceous NNIPs.

Small infestations of herbaceous plants with shallow roots, such as garlic mustard and Eurasian water-milfoil, typically would be treated by hand-pulling. Deeper-rooted herbaceous plants such as purple loosestrife would be dug up with a shovel. Larger infestations, or those persisting in the seedbank or as immature plants, would be smothered, mowed or otherwise cut. Individual shrubs or small groups of shrubs of exotic honeysuckle, buckthorn, and Japanese or common barberry typically would be felled, dug up or girdled. Large infestations of exotic shrubs generally would be treated with chemical rather than manual or mechanical methods.

Proposed Spot Treatments with a Propane Weed Torch

A propane weed torch might be used to spot-burn specific NNIP specimens, especially lone specimens or small clumps of woody species such as ailanthus, Norway maple, and autumn olive. The Michigan Chapter of The Nature Conservancy has used propane weed torches to kill seedlings of buckthorn (Rhamnus spp.), where adult plants have already been removed (Tu et al. 2001). The weed torch works, not by starting a ground fire, but by using the torch's flame to burn the target plant (Flame Engineering Inc. 2003). The weed torch would be used only under a burning plan that addresses timing and control issues.

Proposed Herbicide Use

Objectives of herbicide use would be to control invasive plant species at sites where manual or mechanical means would be cost-prohibitive, or result in excessive soil disturbance or other resource damage. Herbicide application may also be the preferred treatment for certain NNIP species that do not adequately respond to mechanical treatment. Herbicide drift is much reduced with spot treatment. In most cases, herbicides would be applied directly to non-native invasive plants using spot treatment.

Spot treatment consists of various techniques for applying herbicides to target NNIP, with little or no adverse impact to adjacent desirable vegetation and other non-target organisms, including humans. Techniques that may be used include:

- Spraying foliage using hand held wands or backpack sprayers;
- Basal bark and stem treatments using spraying or painting (wiping) methods;
- Cut surface treatments (spraying or wiping);
- Woody stem injections;
- Spot treatments (such as hand wicking);

No herbicides shall be applied aerially. Only formulations approved for aquatic-use shall be applied in or adjacent to wetlands, lakes, and streams, following label direction.

Proposed Herbicides

All herbicides shall be used in strict accordance with manufacturer's labeling directions concerning concentrations, rates, exposure times, and application methods:

2,4-D ([2,4-dichlorophenoxy] acetic acid) is a selective herbicide that controls invasive broadleaf herbaceous plants and woody seedlings, but does not harm certain monocots (including grasses). 2,4-D has been found to be effective at controlling leafy spurge, purple loosestrife, buckthorn, spotted knapweed, exotic thistles, and crown vetch (Lajeunesse et al. 1999, pp. 256-257; Mullin 1999, p. 303; Converse 1984; Sheley et al. 1999, pp. 357-358; Hoffman and Kearns 1997, p. 36, 38; Tu, 2003). Aquatic formulations of 2,4-D are approved for treatment of Eurasian water-milfoil in lakes (Michigan Department of Environmental Quality, 2005a).

Clopyralid (3, 6-dichloro-2-pyridinecarboxylic acid) controls many annual and perennial broadleaf weeds. It is a selective herbicide that controls broadleaf herbs, primarily composites, and legumes. It is particularly effective against members of sunflower, nightshade, and knotweed families. Clopyralid may be used against spotted knapweed, thistles, and crown vetch (Hoffman and Kearns 1997, pp. 39, 45-46; Beck 1999, p. 155; Morishita 1999, p. 169-170). Clopyralid is a pre-emergent and post-emergent herbicide, and so can be effective not only on the plants to which it is applied, but also can prevent germination of seeds in the seed bank.

Dicamba (3,6-Dichloro-o-anisic acid) is a growth regulator effective against broadleaf species. It is a somewhat selective herbicide that controls most annual and perennial broadleaf herbs and some woody species. It is effective against leafy spurge, spotted knapweed, and thistles (Lajeunesse et al. 1999, pp. 256-257; Hoffman and Kearns 1997, pp. 36, 42, 45). It typically is applied in a mix with other herbicides.

Endothall (7-oxabicyclo [2.2.1] heptane-2,3-dicarboxylic acid) is a contact herbicide approved for use in lakes for control of aquatic invasive plants such as Eurasian water-milfoil and curly-leaf pondweed (Michigan Department of Environmental Quality 2005a and 2005b).

Fosamine ammonium salt (FAS) (ethyl hydrogen [aminocarbonyl] phosphonate) is a selective herbicide that inhibits growth in targeted woody species. It is used commonly for brush control (Tu et al. 2001, 7d.1). FAS works through absorption by leaves, stems, and buds. FAS may be used on honeysuckle, buckthorn, and Japanese barberry.

Glyphosate (N-[phosphonomethyl] glycine) is a non-selective, broad spectrum, systemic herbicide that is used to control many grasses, forbs, vines, shrubs, and trees. Specific formulations of glyphosate have been labeled for aquatic application. Glyphosate is effective against garlic mustard, Japanese barberry, leafy spurge, honeysuckle, purple loosestrife, buckthorn, crown vetch, and Japanese knotweed (Hoffman and Kearns 1997, pp.13, 20, 28, 39, 42, 59; Johnson 1996, p. 47; Seiger, 1991).

Sethoxydim (2-[1-{ethoxyimino}butyl] -5[-2-{ethylthio}propyl]-3-hydroxy-2-cyclohexen-1-one) is a selective postemergence herbicide used to control annual and perennial grasses (Tu et al. 2001). It has little or no impact on broadleaf herbs or woody plants. Invasive species on the Forests that may be controlled by sethoxydim include smooth brome or reed canary grass.

Triclopyr ([{3, 5, 6-trichloro-2-pyridinyl}oxy] acetic acid) is a selective herbicide that controls invasive, broadleaf herbaceous and woody plants, but does not harm certain monocots (grasses). It is particularly effective at controlling woody species with cut-stump or basal bark treatments. Triclopyr is effective against garlic mustard, Japanese barberry, exotic honeysuckles, buckthorn, and crown vetch (Hoffman and Kearns 1997, pp.13, 20, 23, 28, 39). Aquatic formulations of triclopyr are available for the control of EWM in lakes (Michigan DEQ 2005a, 2005b).

Table 2-5. Proposed Herbicides, Target Plants, and Site selection Information.

Herbicide	Sample Trade names	Target plants	Site selection
2,4-D	Weed-B-Gon, Brash, many others	Broadleaf herbs & woody seedlings	Would be considered for use if other herbicides did not work. Minimum buffer of 150 feet from surface water. Will not be applied on gravel, sand, sandy loam, or where groundwater is < 10 feet deep.
2,4-D (aquatic-approved)	Aqua-Kleen, Navigate, Aquicide	Eurasian water-milfoil	Lakes[1].
Clopyralid	Stinger, Transline, Curtail	Exotic thistles and crown vetch	Roadsides & rights-of-way. Would be used if other herbicides were not effective. Generally would not be used on well-drained soils where water table is within 10 feet of the surface.
Dicamba	Banvel II, Vanquish	Broadleaf herbs	Often a secondary ingredient with 2,4-D. Same restrictions as 2,4-D.
Endothall	Aquathol K, Hydrothol 191	Aquatic plants	Lakes[1].
Fosamine ammonium salt	Krenite	Woody plants	Would be tried as foliar spray on large, dense, infestations to avoid impacts to neighboring herbs.
Glyphosate	Round-Up, many others	Would be targeted against all upland broadleaf NNIP listed in Table 1-1.	Uplands[2].
Glyphosate (wetland-approved)	Rodeo, Accord	Non-selective. Would be targeted against purple loosestrife, buckthorn, and European swamp-thistle.	Wetlands. Herbicide of first choice for non-aquatic wetland sites.
Sethoxydim	Poast, Vantage, Rezult	Grasses (Smooth brome and reed canary grass).	Minimum buffer of 150 feet from surface water.

Triclopyr	Garlon, Access, Brush-B-Gon, Renovate	Broadleaf NNIP, particularly shrubs.	Uplands and wetlands[2].
Triclopyr (aquatic-approved)	Renovate	Eurasian water-milfoil	Lakes[1].

1. *2,4-D has been favored by local lake associations conducting Eurasian water-milfoil treatments in recent years. Triclopyr would be used as a comparison, and Endothall would be used if the other herbicides were found to be ineffective or otherwise unsuitable. Selectivity would be a consideration where non-target species form a protective barrier against re-invasion. Also see Table A-2.*

2. *Glyphosate and Triclopyr would be the most commonly used herbicides. Glyphosate would be favored for herbs. Either herbicide could be used on shrubs, to determine which provides the best results for each target NNIP species.*

Proposed biological control use

Biological control of NNIP infestations involves releasing specific insects that feed on or parasitize specific target plant species. Most biological control agents are insects native to other parts of the world where target plant species originally arose. All non-indigenous species used as biological control agents must be approved for release in the United States by the United States Department of Agriculture (USDA) Animal and Plant Health Inspection Service (APHIS). An exception is milfoil weevil, which is native to North America. Biological control methods generally suppress host NNIP populations, but do not necessarily contain or eradicate them. Biological control of plants is already a common practice on State, Tribal, County, and private land in Michigan and Wisconsin.
.

Biological control can be effective on dense infestations over large areas (Rees et al., 1996, pp. 13-15). It would therefore be considered for large infestations where eradication is difficult due to cost or undesirable side effects from other control methods. Releases could occur on Huron-Manistee National Forest System lands wherever an infestation of priority non-native invasive plants is identified.

Biological control insects generally are released as adults (not as eggs or larvae) between June and August. Some releases are done simply by emptying a container of insects at a NNIP site. Other releases are done by placing insect-bearing plants at a NNIP site. If a release is successful, the insects will continue to live and reproduce at the infestation site as long as the host plant remains in quantities sufficient to support the insect population. Release sites are monitored for effectiveness of NNIP plant control.

The following are examples of biological control organisms. Other USDA/APHIS approved species might be used as well.

Proposed biological control organisms:

- Black-margined loosestrife beetle (Galerucella calmariensis) for purple loosestrife;
- Golden loosestrife beetle (Galerucella pusilla) for purple loosestrife;
- Loosestrife root weevil (Hylobius transversovittatus) for purple loosestrife;
- Banded gall fly (Urophora affinis) for spotted knapweed;
- VU knapweed seed head fly (Urophora quadrifasciata) for spotted knapweed;
- Copper leafy spurge flea beetle (Aphthona flava) for leafy spurge;
- Brown-legged leafy spurge flea beetle (Aphthona lacertosa) for leafy spurge;
- Black dot leafy spurge flea beetle (Aphthona nigriscutis) for leafy spurge;
- Milfoil weevil (Euhrychiopsis lecontei) for Eurasian water-milfoil.

Black-margined loosestrife beetle has proven effective in trials in the Lower Peninsula of Michigan (Landis et al. 2003). All the listed biological control agents can be released without mechanically crushing non-target vegetation.

Design Criteria

All action Alternatives would adhere to Forest Plan management direction, Forest Service Manual direction, established design criteria, herbicide labels, and assigned monitoring. In addition, the site- and project-specific design criteria listed in Table 2-3 would be implemented with all action Alternatives (Alternatives 2, 3, and 4).

ALTERNATIVE 3 – REDUCED TREATMENT

Alternative 3 was developed in response to public scoping comments that expressed concern over the size and extent of the Proposed Action. Under Alternative 3, the Forests would implement an integrated program to control NNIP infestations on the HMNF as described for Alternative 2, but the acreage treated annually would be decreased to a maximum of 1,000 acres per year. Proposed treatments and protocols would otherwise be as described for Alternative 2.

This treatment can be considered in perspective by comparing it to the overall size of the HMNF, approximately 970,000 acres. Under Alternative 3, the total area subject to treatment would not exceed 1,000 acres of combined treatments per year. This amounts to an annual treatment area of less than 0.10 percent of the entire HMNF.

ALTERNATIVE 4 – Biological, Chemical, Manual and Mechanical Control, with Additional Mechanical Broadcast Herbicide Application and Optional Herbicides

In Alternative 4, the use of manual, mechanical, biological, and chemical control treatments would be as described for Alternative 2 with an additional method of application and five optional herbicides to implement the control NNIP infestations on the HMNF. The additional application method would involve using a rubber tire tractor, crawler tractor, or 4 wheel ATV all fitted with a boom spray or wick device in existing upland meadows or open fields that are being restored to Karner blue butterfly habitat and have large NNIP infestations (e.g. spotted knapweed, St. John's wort, leafy spurge, hoary alyssum, smooth brome grass, reed canary grass, or sweet clovers).. The five optional herbicides, in addition to those already mentioned under Alternative 2, include: aminopyralid, fluridone, imazapic, imazapyr, and metsulfuron methyl.

The use of broadcast herbicide application using a tractor or 4 wheeler with a boom spray arm would be restricted to existing meadows or open fields with large infestations of knapweed, St. John's wort, leafy spurge, hoary alyssum, smooth brome grass, reed canary grass, or sweet clovers that are being restored to Karner blue butterfly habitat. Use of this treatment method would be permitted on up to 40 acres per year.

Specific herbicides that could be used in the project area are listed below. Detailed descriptions of these chemicals including comprehensive risk assessments for each can be found at: http://www.fs.fed.us/foresthealth/pesticide/risk.shtml

- Aminopyralid (4-amino-3,6-dichloro-pyridinecarboxylic acid) is a new selective systemic herbicide that has been developed for the control of broadleaf weeds.

- Fluridone (1-methyl-3-phenyl-5-[3-(trifluoromethyl)phenyl]-4(1H)-pyridinone) is a selective systemic aquatic herbicide used to control primarily broad-leaved, submerged aquatic macrophyte species including Eurasian watermilfoil, curly-leaf pondweed as well as native pondweeds (Mattson 2004).

- Imazapic (±)-2-[4,5-dihydro-4-methyl-4-(1-methylethyl)-5-oxo-1 Himidazol-2-yl]-5-methyl-3-pyridinecarboxylic acid) is a selective herbicide that is used primarily in and around populations of native, warm season grasses.

- Imazapyr (2-[4,5-dihydro-4-methyl-4-(1-methylethyl)-5oxo-1Himidazol-2-yl]-3-pyridinecarboxylic acid) is a selective herbicide that is used primarily in the control of hardwood trees and some species of grasses.

- Metsulfuron methyl (Methyl-2-[[[[(4-methoxy-6-methyl-1,3,4-triazin-2-yl)amino]-carbonyl]amino]sulfonyl]benzoate]) is a selective pre-emergence and post-emergence sulfonyl urea herbicide used primarily to control many annual and perennial weeds and woody plants.

These optional herbicides were selected for Alternative 4 to offer managers greater options of controlling NNIP. These chemicals could provide managers options of choosing chemicals which may be applied in the spring, summer or fall. This additional capability will assist in the management of habitat for ETS species such as Karner Blue Butterfly. Also, having a suite of selective chemicals, which have varying modes of action versus a limited number of broad spectrum herbicides, will allow the manager to choose a chemical that best targets individual NNIP while limiting impact to non target species present. Managers are then able to fine tune prescriptions taking into consideration existing target species, desirable vegetation, soil types, position on the landscape (upland vs. lowland), terrestrial or aquatic, time of year of application, and method of application. The control of NNIP is vital in preserving and protecting the ecological diversity of the land. These chemicals provide the tools necessary for managers to effectively control noxious and invasive plant species.

Alternative 4 was developed in response to comments that expressed concern over the efficiency and effectiveness of spot herbicide applications in the restoration of Karner Blue Butterfly habitat and increasing the flexibility of managers in selecting appropriate herbicides.

Table 2-6. Alternative 4 Proposed Herbicides, Target Plants, and Site selection Information.

Herbicide	Sample Trade names	Target plants	Site selection
2,4-D	Weed-B-Gon, Brash, many others	Broadleaf herbs & woody seedlings	Would be considered for use if other herbicides did not work. Minimum buffer of 150 feet from surface water. Will not be applied on gravel, sand, sandy loam, or where groundwater is < 10 feet deep.
2,4-D (aquatic-approved)	Aqua-Kleen, Navigate, Aquicide	Eurasian water-milfoil	Ponds, Lakes[1].
Aminopyralid	Milestone	Broadleaved weeds and invasive plants(spotted knapweed	Up to the waters edge
Clopyralid	Stinger, Transline, Curtail	Exotic thistles and crown vetch	Roadsides & rights-of-way. Would be used if other herbicides were not effective. Generally would not be used on well-drained soils where water table is within 10 feet of the surface.
Dicamba	Banvel II, Vanquish	Broadleaf herbs	Often a secondary ingredient with 2,4-D. Same restrictions as 2,4-D.
Endothall	Aquathol K, Hydrothol 191	Aquatic plants	Ponds, Lakes[1].
Fluridone	Sonar	Aquatic plants (ex. Eurasian Watermilfoil, curlyleaf pondweed)	Ponds, Lakes
Fosamine ammonium salt	Krenite	Woody plants	Would be tried as foliar spray on large, dense, infestations to avoid impacts to neighboring herbs.

Glyphosate	Round-Up, many others	Would be targeted against all upland broadleaf NNIP listed in Table 1-1.	Uplands[2].
Glyphosate (wetland-approved)	Rodeo, Accord	Non-selective. Would be targeted against purple loosestrife, buckthorn, and European swamp-thistle.	Wetlands. Herbicide of first choice for non-aquatic wetland sites.
Imazapic	Plateau, Cadre	Some annual and perennial grasses and some broadleaf weeds	Uplands
Imazapyr	Arsenal	Annual and perennial grasses, broadleafs, vines, brambles, brush, and trees	Uplands not for aquatic use
Metsulfuron methyl	Ally, Allie, Gropper, and Escort	Selective on broadleaf weeds and some annual grasses	
Sethoxydim	Poast, Vantage, Rezult	Grasses (Smooth brome and reed canary grass).	Minimum buffer of 150 feet from surface water.
Triclopyr	Garlon, Access, Brush-B-Gon, Renovate	Broadleaf NNIP, particularly shrubs.	Uplands and wetlands[2].
Triclopyr (aquatic-approved)	Renovate	Eurasian water-milfoil	Lakes[1].

1. *2,4-D has been favored by local lake associations conducting Eurasian water-milfoil treatments in recent years. Triclopyr would be used as a comparison, and Endothall would be used if the other herbicides were found to be ineffective or otherwise unsuitable. Selectivity would be a consideration where non-target species form a protective barrier against re-invasion. Also see Table A-2.*

2. *Glyphosate and Triclopyr would be the most commonly used herbicides. Glyphosate would be favored for herbs. Either herbicide could be used on shrubs, to determine which provides the best results for each target NNIP species.*

2.4 IMPACT REDUCTION MEASURES

The most prominent concerns voiced during the public scoping process were potential physical and socioeconomic impacts this proposal could have on the honey bee industry.

To the extent practical, the analysis identifies native replacements that can be planted where prominent non-native nectar producers are disturbed or eradicated. Specifically, this EA investigates the feasibility of planting native Allegheny plum and staghorn sumac as replacements for autumn olive. Similarly, native milkweeds, including butterfly weed, and other nectar species can replace spotted knapweed or other nectar producing non-native invasive species. There is currently no commercially available native source for brambles (Rubus spp.), although cultivated raspberries and blackberries provide the same benefits. The EA also investigates the feasibility of developing a native source for brambles for use in replacement planting.

2.4.1 ALTERNATIVES CONSIDERED BUT NOT EVALUATED IN DETAIL

Alternatives 5, 6, 7 and 8 were considered but later dismissed from detailed analysis.

ALTERNATIVE 5 – No Biological Controls

Under Alternative 5, the HMNF would implement a program to control NNIP infestations on the HMNF as described for Alternative 2, but the program would not include the use of biological control agents. The use of manual, mechanical, and chemical control treatments would be as described for Alternative 2. Alternative 5 was developed in response to comments that expressed concern over the potential for unintended consequences from the release of regionally non-indigenous insects.

This alternative limits the use of integrated pest management practices by eliminating the option of biological controls. Removing these controls from the options for treatment of the listed NNIP plant species would cause this alternative to fail to meet the purpose and need for action by reducing the potential for successfully treating some NNIP outbreaks effectively and cost efficiently. Manually and mechanically cutting purple loosestrife has shown to be expensive and ineffective, as the plants resprout, often increasing the size of the outbreak. Herbicide application to control purple loosestrife infestations is difficult due to the wetland habitats in which they most often occur, and access difficulties associated with these wet areas.

ALTERNATIVE 6 – Manual, mechanical and biological, but no chemical, controls

Under Alternative 6, the Forests would implement a program to control NNIP infestations on the HMNF as described for Alternative 2, but the program would not include the use of chemical controls. The use of manual, mechanical, and biological control treatments would be as described for Alternative 2.

This Alternative limits the use of integrated pest management practices by eliminating the option of chemical controls. Removing these controls from the options for treatment of listed NNIP plant species would cause this Alternative to fail to meet the purpose and need for action, by reducing the potential for successfully treating some NNIP outbreaks effectively and cost efficiently. NNIP such as autumn olive and honeysuckle resprout after being cut. Mechanical control of these species usually requires multiple treatments over 3-5 years.

Conservation Measures for chemical control actions will be applied to Alternatives 2, 3 and 4. The effects of Chemical control are disclosed in the Effects section of this document.

ALTERNATIVE 7 – Same as the Proposed Action but excludes certain species from the list of non-native species potentially to be treated: autumn olive, black locust, Scots pine, spotted knapweed, purple loosestrife, and white and yellow clovers would not be treated.

By eliminating the above species from the NNIP treatment list this Alternative fails to meet the purpose and need for action, because spotted knapweed, autumn olive, and purple loosestrife are some of the most prolific spreaders. This Alternative would fail to provide the Forests the ability to reduce the rate of spread of NNIP species in priority areas.

Conservation Measures applied to Alternatives 2, 3 and 4 would provide for replacement of nectar produced by these species. Effects of treatment are disclosed in the Effects section of this document.

ALTERNATIVE 8 – prescribed burning to control NNIP

Under this Alternative prescribed fire would be used to control NNIP instead of mechanical, chemical or biological controls. Treatment would occur on large areas, burning target and non-target vegetation in these sensitive locations. This may be detrimental to some non-target species, both plant and animal, including pollinating insects.

Additionally, some areas of NNIP infestation could be burned as part of the ongoing program of prescribed burning conducted on the Forests. As part of the 2006 Forest Plan, the Forests already use prescribed burning to maintain or restore certain vegetation types such as jack pine forest that are incapable of persisting without periodic fire, and to prevent accumulation of excessive levels of flammable understory vegetation and leaf cover capable of fueling catastrophic wild fires. The Forests have already documented potential environmental impacts from their program of prescribed burning in the environmental documentation (including a BE and Environmental impact statement) recently completed for the updated Forest Land & Resource Management Plan (USDA-Forest Service. 2006).

By limiting the treatment options for infestations to burning only, this alternative would not meet the purpose and need of this project. Some NNIP species are enhanced by burning. Some infestations may occur in areas where burning may be hazardous, particularly during the season when burning would be required to effectively control NNIP. In order to burn some areas, containment lines would have to be constructed, and this ground disturbance could encourage other NNIP, or may not be suitable for some sensitive areas where NNIP treatment is required.

2.5 MONITORING

The Forest Service would periodically monitor treated areas to ensure that control measures and site protection measures meet objectives.

Additionally, herbicide monitoring would be completed daily and annually during periods of herbicide application. Records would include information on the date of application, type of herbicide, total amount of herbicide used, method of application, species treated, and location of treatment. This information would be entered into the activity-tracking database, (currently FACTS) and consolidated in the annual Forest Service Pesticide Use Report. Appropriate monitoring techniques, or other evaluations, could be used, as appropriate (FSH 2109.14).

Areas of soil left bare of vegetation following such treatment would be monitored for effectiveness and any need for revegetation to stabilize the soil until desired native species re-colonize the site.

Chapter 3 AFFECTED ENVIRONMENT

This chapter describes environmental resources that potentially might be affected by taking actions to control the spread of non-native invasive plants (NNIP) on the Huron-Manistee National Forests (HMNF). This project is planned under the regulation at 36 CFR 219.35 (2000) and the Interpretive Rule of September 29, 2004.

Best Available Science has been used in this analysis. The project record demonstrates a thorough review of relevant scientific information, consideration of responsible opposing views, and, where appropriate, the acknowledgment of incomplete or unavailable information, scientific uncertainty, and risk. The complete analysis, including maps and supporting documentation, is included in the project file.

GEOGRAPHICAL LOCATION AND SETTING

The Huron-Manistee National Forests (HMNF) consist of two distinct units located in the northern Lower Peninsula of Michigan. Combined, the HMNF administer approximately 970,000 acres of National Forest System lands within proclamation boundaries encompassing 2,021,090 total acres (see Figures 3-1 and 3-2). For administrative purposes, the Huron and Manistee National Forests were combined in 1945. District Ranger station offices are located in Mio, Oscoda, Manistee, and Baldwin; the HMNF headquarters is in Cadillac.

Located on the east side of Michigan, the Huron unit is approximately 60 miles wide (running east to west) and varies between 12 to 30 miles long (running north to south). The Forest bounds Lake Huron near East Tawas. The unit of lands which now make up the Huron National Forest (HNF) was established in 1902. Most HNF land was acquired through land-for-land exchanges and individual purchases. The HNF was formally established in 1909; the present day Forest boundary includes approximately 692,000 acres, of which about 435,000 acres (63 percent) are National Forest System lands.

Situated on the west side of the state, the Manistee unit is approximately 40 miles wide (running east to west) and 75 miles long (running north to south). The Forest touches Lake Michigan near Manistee. The unit constituting the Manistee National Forest (MNF) was created in 1933. The MNF was formally proclaimed in 1938, its boundary encompassing approximately 1,328,000 acres. Of that amount, about 535,000 acres, or 40 percent, are National Forest System lands. While a majority of MNF lands were purchased from private owners, a significant portion was also acquired through State and private land-for-land exchanges.

The climate is temperate, with 26 to 34 total inches of precipitation annually, evenly distributed throughout the year.

Topography of the HMNF varies from near level, associated with swamps and lakes, to undulating and broken, associated with pitted outwash and moraines. The abundance of rivers, lakes, and wetlands is a result of most-recent Wisconsin episode glacial action. The HMNF are well known for high quality cold water streams.

Approximately 95 percent of HMNF land is forested, of which 92 percent is capable of commercial timber production. Hardwoods are the most common trees on the HMNF, including red and black oak, aspen, sugar maple, white and black ash, and red maple. Common softwood trees include red, jack, and white pine, balsam fir, northern white cedar, white and black spruce, eastern hemlock and tamarack (larch).

3.1 BIOLOGICAL RESOURCES

"Non-native" refers to organisms introduced by humans to locations outside their natural or native range. Numerous non-native species exist in relative harmony, and are "desired" (e.g., ring-necked pheasants, rainbow and brown trout, Coho and Chinook salmon, etc.) in environments where they have been introduced. Some non-native plants (e.g., corn, wheat, rice) actually form the basis for much of modern agriculture, and are unable to persist outside cultivation.

"Invasive" refers to organisms that spread rapidly, establish themselves over large areas, persist, and replace native species. Such species are characterized by high reproductive rates, abundant seed or offspring reproduction, high germination or survival rate, and longevity in the ecosystem. Some invasive species (e.g., ornamental honeysuckles, autumn or Russian olive) are considered "desirable," by some people.

Examples of highly impacting, undesirable non-native invasive species (NNIP) that exist in the HMNF include spotted knapweed, emerald ash borer, round goby, zebra and quagga mussels, brown-headed cowbird, sea lamprey, gypsy moth, and purple loosestrife.

Current Condition of NNIP on the Huron-Manistee National Forests

Exact levels of infestations across the HMNF are not known at this time. In 2002 an estimated 84,000 acres of the HMNF were infested by NNIP (USDA 2003). A conservative estimate, based on national averages of rate of spread for invasive plant species, indicates an increase of approximately three percent annually. This increases the current estimate of infested acres across the HMNF to approximately 102,000 acres (See Table 1-2). New invasive plant infestation sites are reported frequently.

A list of 58 NNIP species of concern has been prepared for the HMNF (See Table 1-1). Weed inventories and site reporting, along with regional invasive plant information; have been used in developing this list. Risk assessments have determined all plants on the list to negatively affect natural plant habitat. Category 1, 2, and 3 species are either actively spreading in undisturbed habitats, or are considered to pose a risk of such invasive behavior. We prioritized NNIP into treatment categories 1 - 3 because of the ability to still have an impact in effectively reducing or eliminating an NNIP species from an area. These infestations are the primary focus of the Forests' NNIP control program. Category 4 and 5 NNIP species are those that are either already prevalent on the Forests or species that spread slowly. These species are mainly addressed through other projects such as timber sales and trail construction when particular infestations are a resource concern.

Throughout the HMNF, non-native invasive plants are most abundant in regularly disturbed areas, such as along roadsides. Table 1-2 provides an estimate of NNIP occurrences within the HMNF.

Invasive plants on the HMNF are currently spread by a variety of methods. Exotic honeysuckles, autumn olive, and Japanese barberry all have fruits that are dispersed primarily by birds. Other species are spread largely by wind, animals, water currents or inadvertently by people on their clothes or vehicles (cars, mowers, ORVs, boats, etc.), or in hay or straw for livestock. Transporting soil or gravel infested with weed seeds also contributes to the spread of invasive plants along roads and in parking lots.

Scattered private land ownership within and adjacent to the Forests' proclamation boundaries, and heavy recreational use on the HMNF, make it challenging to achieve HMNF management objectives for controlling the spread of NNIP species. A complex network of roads, in combination with high traffic density, provides corridors for the spread of invasive plants across the Forests. Landowners within HMNF boundaries unknowingly provide new sources of such popular ornamentals as purple loosestrife and non-native honeysuckles, which are both highly invasive. Some users disregard road closures. Unauthorized off-road vehicle use, and other unauthorized activities (such as dumping yard waste) provide avenues of NNIP spread in both upland and wetland areas.

The HMNF manage an active invasive plant prevention and education program. Forest and public education emphasizes NNIP identification and prevention methods. On-the-ground actions generally follow United States Department of Agriculture (USDA) guidance, the Forest Service Guide to Noxious Weed Prevention Practices (USDA Forest Service 2001a). Non-invasive species are used to reseed disturbed ground following project activities, and a mandated program for the use of native plants in revegetation projects is now in development. Non-native invasive plant inventories are conducted during pre-project resource surveys. The Forest Plan directs that steps be taken, such as equipment inspection and cleaning, and pre-treatment of invasive plants before timber harvesting, to reduce or eliminate spread of invasive seeds or propagules (e.g., structures that can give rise to new organisms) during project implementation.

Forest Service actions to control NNIP plants go beyond that proposed in this document. Since 2002 the Forests have treated approximately 200 acres for control of NNIP. It is expected that in 2009 a total of 200 acres will be treated, and that this amount of NNIP species treatment will slowly increase (at an estimated rate of 50-100 acres per year for the next few years.)

Table 3-1 Estimated Levels of NNIP Infestations on the Huron-Manistee National Forests.

	2002 Percent Infested	2002 Acres Infested	Projected 3% Annual Increased Spread by 2008 (acres)
Roadsides	80%	10,000	12,000
Landtype Associations* 1 and 2	10 %	60,000	73,000
Riparian Areas	5 %	5,000	6,000
Other LTAs	3 %	9,000	11,000
Total		84,000	102,000

* Landtype Associations. See Forests' Ecological Classification and Inventory System (Cleland 1994)

Since 2002, approximately 200 acres of the HMNF have been treated to control the spread of NNIP. Thus far, control has been conducted almost entirely by manual means. Herbicide use for invasive plant control has occurred only on small patches of purple loosestrife and garlic mustard located within administrative sites and 10 acres of reed canary grass in the Black River Candidate Research Natural Area. Individual autumn olive shrubs were also treated in 2005 with glyphosate application to cut stumps in a timber sale project area.

Use of biological agents by the Forest Service to control NNIP

Biocontrol methods generally suppress host NNIP populations, but may not contain or eradicate them. Biological control can be effective on dense infestations over large areas (Rees et al., 1996, pp. 13-15). To-date, the Forest Service has made limited biocontrol releases. Early releases of *Galerucella pusilla* did not establish well in Michigan, and subsequent releases have been limited to the beetle *Galerucella calmariensis*. at 7 sites on Cadillac/Manistee Ranger District, 3 sites on Mio Ranger District, and 7 sites on Huron Shores Ranger District. Monitoring at these release sites indicates that some levels of control are being achieved.

Native and Non-Native Invasive Species: Important Insects and Diseases of Trees

Native forest pests recently causing mortality include pine tip blight (*Sphaeropsis sapinea*), jack pine budworm (*Choristoneura pinus pinus*), oak wilt (*Ceratocystis fagacearum*), and oak decline.

Oak wilt is a native fungal disease and is widespread in eastern North America. No species of oak is known to be immune to this vascular disease. Infections have been found in 16 native oak species, including most of those of commercial importance. Red oak species get the disease more frequently and succumb more readily than white oaks. Several pockets of oak wilt have been identified on the Baldwin, Manistee, and Mio Ranger Districts, most of them associated with residences and recreation sites in the Peacock, Dublin, Loon Lake, Mio, and Fairview areas.

Oaks have declined over widespread areas of the HMNF. Drought and other environmental factors stress the trees and make them susceptible to attack by insects and diseases. Two pests most commonly associated with oak decline are the two-lined chestnut borer (*Agrilus bilineatus*) and armillaria root rot (*Armillaria mellea*). Both red and white oaks are susceptible to oak decline, but may not be affected at the same time due to variation in stressors and forest pest populations. Northern pin oak on Huron National Forest showed significant decline in 2003 and 2004.

In unmanaged forests, native insects and diseases may beneficially affect forest growth, by killing weaker trees and thus providing growing space for more vigorous trees. Both native and non-native forest pests affect species composition and age classes of the forest.

In 2000 through 2002, the incidence of pine trees infected with pine tip blight increased. This fungus kills seedlings, but large trees also can be killed or deformed by repeated attacks. From the mid 1990s through 2001, droughts stressed young jack pine, making them more susceptible to *Sphaeropsis sapinea*, resulting in lower than normal survival on poor sandy soils. Return of normal rainfall after 2001 decreased mortality attributable to the fungus.

Jack pine budworm is the most significant pest of jack pine in North America. Since 2001, jack pine budworm populations have increased. The budworm is cyclic: populations build up in stands with a high percentage of male/pollen cones, poor stocking, and mature and over-mature jack pine. Budworm populations are expected to decline within a few years. Damage surveys in 2007 were conducted to assess potential tree mortality and project future volume losses. In the Lower Peninsula, affected stands were only lightly or moderately defoliated. Little mortality or top kill is expected in these stands in 2008.

In contrast, non-native insects and diseases can have much more adverse and dramatic effects, in some cases eliminating native tree species from the forest environment. Several non-native insects and diseases impact the HMNF, notably Beech bark disease, European gypsy moth, and Emerald ash borer. Others have the potential to impact the HMNF, including Sirex wood wasp and Asian long-horned beetle.

First discovered in Michigan in 2000, Beech bark disease is widespread on the Manistee National Forest. It affects both American beech (*Fagus grandifolia*) and European beech (*Fagus sylvatica*). Beech bark disease will negatively affect wildlife and human populations that rely on mature beech for mast (beech-nut) production. No preventative or palliative treatment is known, other than prevention of injury to live susceptible trees.

First discovered in the United States in 1996, the Asian long-horned beetle (*Anaplophora glabripennis*) has the potential to dramatically impact maple resources on the Forests, but has not yet been detected in the State of Michigan.

In the late 1990s, Emerald ash borer (*Agrilus planipennis*, EAB), a wood boring beetle, was introduced accidentally to Michigan from China. All ash species (Fraxinus spp.) are susceptible. This pest has the potential to largely remove the ash component from forest environments. Known native predators of EAB only affect less than 1 percent of the EAB population. Three egg and larvae predators, native to China, have been approved as biological controls, as the only practical means of reducing EAB populations. One of these species, *Tetrastichus planipennisi*, was released near Lansing, Michigan in 2007. EAB has spread rapidly, as far north as Sault Ste. Marie. Human transportation of firewood has accelerated its infestation from the southern part of the state, northward.

Several forest pests impact oak resources of the HMNF. During the 1990s, Gypsy moth became established across the entire lower peninsula of Michigan, but has not caused significant damage on the HMNF since that time. In recent years, dramatic collapses of gypsy moth populations in eastern states are due, in large part, to the fungus *Entomophaga maimaiga*. A native of Japan, this fungus is a natural enemy of gypsy moth larvae. It is unknown when the moth population may begin an upward trend again.

Sirex wood wasp (*Sirex noctilio*), an Asian wood borer affecting many species of conifers, was detected in Macomb county, Michigan in 2007. This species can cause mortality to economically-valuable red, jack, and white pines. Native and non-native nematode species are potential biological controls being evaluated for this pest.

Many other insect and disease problems (e.g., hemlock woolly adelgid) exist within the HMNF, but do not currently have a high potential for widespread adverse impacts.

Nitrogen-Fixing Plants

Nitrogen is generally the most difficult nutrient for plants to acquire. While nitrogen is the most abundant atmospheric element, most organisms are unable to obtain nitrogen necessary for biological processes directly from the atmosphere. Instead, most plants obtain mineral forms of nitrogen from the soil or from mycorrhizal fungi around their roots. Animals depend on organic nitrogen produced by plants.

Nitrogen-fixing plants include members of the legume family (peas, beans, and their relatives), alders, and other shrubs. A plant is said to be nitrogen-fixing if it has the ability to extract atmospheric nitrogen directly into its roots because of an alliance with certain bacteria. These bacteria extract nitrogen gas from the air, convert it to organic forms of nitrogen, and make it available to their host plant. The host plant, in return, provides the bacteria with food that they are unable to manufacture by themselves. Many nitrogen-fixing plants enrich the soil with nitrogen, making it possible for other species to establish themselves. Many of these plants are also significant sources of protein in the human diet.

One issue voiced during the public scoping process for this EA was that loss of nitrogen-fixing plants would adversely affect the nitrogen cycle of native communities adapted to infertile soils. This commenter stated that non-native black locust and autumn olive should be retained to hold and enhance soil conditions as they were planted to do. This issue is evaluated in Chapter 4.

Food Source

Some NNIP provide a food source for wildlife in winter. One comment received from the NEPA public scoping process stated that removal of autumn olive would be harmful to wildlife as it provides a needed winter food source. This issue is evaluated in Chapter 4.

Re-establishment of Organisms

Some plants such as non-native Scots pine may support the reestablishment of trees such as oak and hardwoods. One comment received from the NEPA public scoping process stated that removal of Scots pine will be harmful to the re-establishment of oak and hardwoods. This issue is evaluated in Chapter 4.

Use of Biological Control Agents

Use of biological control agents to treat NNIP within the HMNF has been limited. The Forest Service has only released *Galerucella* beetles on purple loosestrife as part of a partnership activity conducted with Michigan State University Extension (MSUE). Other agents have been released in Michigan under the auspices of MSUE and Michigan Department of Agriculture. Substantial work, particularly at Michigan State University, has been done on how various biological control agents might affect Endangered species and nontarget insects. For example, *Urophora affinis* and *Urophora quadrifasciata*, flies that attack the flower head of spotted knapweed, were released elsewhere in Michigan in 1994. The stem boring beetle, *Oberea erythrocephala*, the shoot tip gall midge, *Spurgia esula*, and flea beetles in the genus *Aphthona* were released in the late 1980's through the mid 1990's in Michigan to attack leafy spurge. Some concerns have been raised about the proposed use of non-native insects to attack and control NNIP. For instance, one commenter stated that proposed use of biological control agents is unnecessary and/or may be harmful to other insects, wildlife, and vegetation. This issue is evaluated in Chapter 4.

Riparian Areas

Riparian systems provide an interface between aquatic and terrestrial systems. They consist of perennial rivers, streams, ponds, lakes, wetlands, and adjacent lands with soils, vegetation and landform indicative of high soil moisture or frequent flooding. These areas have variable widths, determined by ecologically significant boundaries rather than by arbitrary or uniform distances.

Riparian systems support a variety of often unique plants and animals; they enhance water quality, attenuate floods, and reduce erosion and sediment transport (Brooks et al. 1997).

Wetlands

Wetlands occur within all Landtype Associations, but are most common in Landtype Associations 4 (Wet Sand Plains and Lake Plains) and 5 (Alluvial, Fluvial, and Organic).

Classification of wetland habitats has been standardized by USDI Fish and Wildlife Service (Cowardin et al. 1979) and mapped in the National Wetlands Inventory. Using this classification system, wetland vegetation on the HMNF falls into 6 major wetland classes: Aquatic Bed, Unconsolidated Shore – Vegetated, Moss-Lichen Wetland, Emergent Wetland, Scrub-Shrub Wetland, and Forested Wetland.

Within the wetland classes, specific wetland communities on the HMNF have been identified as being of particular concern. These rare wetland plant communities include coastal plain marsh, intermittent wetland, southern floodplain forest, cedar swamp, Great Lakes marsh, interdunal wetland, northern wet-mesic prairie, northern fen, and poor fen. These communities are addressed further in Sections of this document on Endangered, Threatened, and Sensitive communities, animals and plants.

3.1.1 Vegetation Diversity

Vegetation diversity is defined in this section as the species richness and variety of vegetation by age, type, structure, and spatial pattern. Vegetative diversity traditionally has focused on the timber species within forest communities. However, in the past decade, herbaceous and subcanopy trees and shrub species have also come into consideration on the Forests, and in ecosystem descriptions.

Several Endangered, Threatened, and Regional Forester's Sensitive (ETS) species are key parts of communities that compose the ecosystems of these Forests. Emphasis is placed on protecting these ETS species and communities through management of individual species and their habitats across the landscape, and management or protection of communities in Research Natural Areas.

Vegetation Diversity – Former (Mid-1800s)

Data on early vegetation of the area are found in notes from the General Land Office surveys of 1816-1856. The entire area was not covered by continuous forest, even though most early explorers describe it that way.

Based on descriptions of witness and bearing trees, oak/pine type was dominant, covering approximately 65 percent of the area. Species composition varied from red oak and white and red pines on more productive sites, to black oak on less productive sites. About 20 percent of the area supported other hardwoods. This type included primarily sugar maple, beech, yellow birch, hemlock, and white pine, which was principally found on productive soils in the morainal hills.

Pine types were found on about 10 percent of the area. Primary species were white, red, and jack pines, the latter generally found on sandy soils.

Lowland conifer and lowland hardwood types were scattered throughout the HMNF along rivers and streams. These types covered less than 10 percent of the Forests' area.

Vegetation Diversity -- Present (2003)

The Huron-Manistee National Forests cross a range of landscapes including lakeshores, dunes, sandy outwash plains, sand hills, wet lake plains, river floodplains, various pocket wetlands, and loamy morainal hills. As a result of this range of landscapes, up to half of Michigan's 2097 native vascular plant species may occur on the Huron-Manistee National Forests.

To a large degree, vegetation found on the HMNF today has survived post-European settlement-period forest harvests and associated wildland fires (1830 – 1920), wind erosion, fire control efforts after 1910, and extensive reforestation programs carried out between 1920 and 1990.

Many open areas were planted with red, white and jack pine. These trees, and the young stands that existed when the HMNF were established, are maturing, and provide a variety of timber products and recreational settings. Fragmentation, non-native invasive species, and browsing by increasing white-tailed deer populations are a few other interrelated factors that have altered plant species diversity.

Rare plant species and plant communities occur across these landscapes. As a whole, Michigan has lost 46 native plant species in recent times; currently the State has 51 State-listed Endangered plants, 210 State-listed Threatened plants, and 110 plants of Special Concern. About 23% of Michigan's native plant species are considered at risk. Rare upland communities found on the Forests include Dry Sand Prairies, Great Lakes Barrens, Interdunal Wetlands, Open Dunes, Oak Barrens, Oak-Pine Barrens, and Pine Barrens.

The present mixture of vegetative types and age classes provides diverse habitats for a variety of wildlife species.

3.1.2 Fish and Mollusks

A total of 118 fish species and 16 mollusk species inhabit HMNF lakes and perennial streams. Cold water species include native brook and introduced brown and rainbow trout. Most cold water streams that are free flowing to Lake Michigan or Lake Huron have populations of introduced anadromous salmonids, including chinook and coho salmon, and steelhead (anadromous rainbow) trout.

Large-mouth bass, small-mouth bass, northern pike and walleye are the Forests' major warm-water game fish species. Bluegill, sunfish, and yellow perch are common panfish found in most of the Forests' warm-water lakes and larger streams.

3.1.3 Wildlife

The HMNF are inhabited by 264 species of breeding vertebrate animals, other than fish. These species include:

- 168 species of birds;

- 54 species of mammals;
- 24 species of reptiles; and
- 18 species of amphibians;

Additionally, there are numerous invertebrates, primarily insects found in the HMNF.

Many wildlife species inhabit portions of the HMNF where timber has been harvested in the past 10 to 15 years and new growth now exists. Species such as chestnut-sided warbler, ruffed grouse, and golden-winged warbler inhabit early-successional areas covered with young deciduous trees. Lincoln's sparrow prefers young conifers, and Kirtland's warbler nests only in young jack pine stands found on dry sand plains within and adjacent to the Huron National Forest. Scarlet tanager prefers maturing hardwood stands, while black-throated green warbler nests in maturing conifer stands.

Wetland, lake, and stream riparian borders provide habitats for waterfowl and a wide variety of other water-oriented species. Sandhill crane has reestablished itself in bogs and marshes of the HMNF. Several predatory raptors inhabit the HMNF, from bald eagles to tiny saw-whet owls. A number of heronries are found in wooded swamps. Streams and lakeshores provide habitats for shorebirds such as spotted sandpiper, and Lake Michigan beaches are Critical Habitat for Endangered piping plover. A variety of woodpeckers, including black-backed and pileated woodpeckers, inhabit mature old-growth and fire-damaged stands in the HMNF.

Amphibians and reptiles are primarily associated with aquatic and wetland habitats, but a few seek drier conditions. Some (such as the Sensitive eastern massasauga rattlesnake) use both wetlands and drier uplands. Hognose snakes and blue racers may be found in dry woodlands and brushy areas.

Mammals are found in a wide variety of habitats and habitat conditions within these Forests. White-tailed deer inhabit all areas, but are most abundant where a significant portion of forest is in young stands of aspen, in jack pine, or in oak, or where there are grassy or brushy openings. Beavers inhabit headwater streams. Gray and fox squirrels are found in maturing hardwoods, especially where there are oaks. Northern flying squirrels occupy mature and old-growth stands where tree cavities provide dens, and dense canopies permit growth of arboreal lichens in upper portions of the trees.

Endangered, Threatened and Sensitive species are part of ecosystems that make up biotic communities of the HMNF. The HMNF also provide habitat for numerous migratory species in addition to those species breeding or living year-round in the Forests.

3.1.4 Pollination, Agriculture and the Honey Bee Industry

Non-native domesticated European, "Common," or Italian honey bees are adapted to feeding on nectar and pollen, and play an important role in pollinating flowering plants. Their use as pollinators in the U.S. benefits primarily agricultural/ornamental uses, as no native plants require honey bee pollination, except where concentrated in monoculture situations (i.e., where the pollination need is so great at bloom time that pollinators must be concentrated beyond the capacity of native bees). In 2000, the U.S. crop value dependent on honey bee pollination was estimated to exceed $15 billion (Morse et al. 2000). Honey bees are responsible for pollinating approximately one third of United States' crops, including cherries, raspberries, blackberries, cranberries, watermelons, cantaloupes, almonds, peaches, soybeans, apples, pears, cucumbers and strawberries.

Honey bees may focus on gathering nectar or on gathering pollen, depending on their greater need at the time. Bees gathering nectar may accomplish pollination, but bees that are deliberately gathering pollen are more efficient pollinators. Beehives can be moved from crop to crop as needed, so that honey bees visit many plants in large numbers, and through sheer numbers compensate for their lower pollination efficiency.

Beekeepers collectively earn much more from renting their bees out for pollination than they do from honey production. Beekeepers commonly move their hives to different agricultural locations; migratory beekeeping is now widespread in America.

Nectar is a sugar-rich liquid produced by flowers to attract pollinating animals such as bees. Nectar is economically important as the sugar source used by bees in making honey. One of the most prominent issues voiced during public scoping for this Environmental Assessment (EA) was that loss of nectar-producing plants would harm bee populations and other pollinating insects. Beekeepers were particularly concerned about the economic effect this would have on their honey and bee industry. For example, one comment stated that loss of nectar-producing plants (most importantly to the commentor, non-native invasive spotted knapweed, white sweet clover, yellow sweet clover, and purple loosestrife) would harm bee populations and other pollinating insects. Another comment stated that loss of pollinators caused by this action will reduce the ability of beekeepers to pollinate Michigan's fruit crops, and cause economic loss to surrounding agriculture. Another commenter stated that nectar-producing NNIP should be replaced with alternative nectar sources (basswood, milkweed, brambles [raspberries and blackberries] or butterfly weed). These issues are addressed in Chapter 4.

3.1.5 Endangered, Threatened and Sensitive Animals and Plants

The terms Endangered and Threatened are legal definitions under the Endangered Species Act of 1973 (16 U.S.C. 1531-1544, 87 Stat. 884), that describe the relative potential of a species becoming extinct.

Similarly, the term Sensitive refers to those species identified by the Regional Forester for which National Forest management programs and activities may or may not have an adverse effect, leading to a trend toward listing as Endangered or Threatened. These ETS species may have appeared in the Federal Register as Proposed or Candidate species under review for official listing as Endangered or Threatened, or are recognized by the Regional Forester as needing special management in order to prevent the need for Federal listing under the Endangered Species Act (Forest Service Manual 2672.11). A list of Endangered, Threatened, and Sensitive species can be found on the Eastern Region website (http://www.fs.fed.us/r9/wildlife/tes).

3.2 SOILS, HYDROLOGY, AND WATER QUALITY

3.2.1 Soils

Huron-Manistee National Forests' soils have been formed in deep glacial deposits of unconsolidated sand, gravel, and clay, less than 12,000 years old. Depth to bedrock can exceed 600 feet. Excessively well- to moderately-drained soils underlie 90 to 95 percent of uplands within the Huron-Manistee National Forests.

While the Forests' soils have principally sandy surface textures, vegetation production differs as much as eightfold, depending on the ecosystem and subsoil features. Due to their generally rapid percolation rates and gentle topography, most soils on the Forest pose only slight to moderate constraints on management activities. Low compactability of the well-drained soils and high water permeability help minimize most adverse impacts associated with management activities.

3.2.2 Geology

The HMNF are located in a sedimentary basin having a fairly complete stratigraphic record consisting principally of rocks of marine origin. The low relief, permeable soils and vegetative cover combine to minimize erosion. There are no known bedrock outcrops on the HMNF.

Bedrock under the HMNF are buried by deposits left from repeated glaciation during the Pleistocene Epoch. Glaciers came down the Great Lake basins, then left glacial deposits in lower current-day Michigan, piling as much as 1,000 feet of sand, gravel and clay in places. Average thickness of unconsolidated glacial deposits is about 400 feet.

3.2.3 Water Resources

Rapid infiltration of water into the soil and heavy vegetation discourages overland water flow. The above characteristics contribute to very stable flows of groundwater and surface water systems. Stream flows from the HMNF occur at a relatively even rate, of high quality.

Lakes

Approximately 1,500 lakes totaling about 17,000 acres, and an estimated 3,364 miles of rivers and streams lie within HMNF proclamation boundaries. The lakes are mesotrophic (moderately productive) and "warm water" in nature, with summer temperatures reaching well into the 70°F range.

Groundwater

Increasing demand for groundwater use has prompted the State of Michigan to draft policy and legislation regarding groundwater use.

Stream systems on the HMNF lie above deep glacial deposits of unconsolidated sand and gravel (primarily) with minimal clay deposits, and are heavily influenced by groundwater inputs. These stream systems' flows are predominated by groundwater discharge resulting in an extremely stable flow regime, with great dependability from year to year (Velz and Gannon 1960). Most are within that category of the most stable stream systems in Michigan with 5 percent exceedance (high) flows that are less than twice their median flow, and 95 percent exceedance (low) flows that are more than 80 percent of their median flows.

Streams and Rivers

Water courses within the Forests' boundaries consist of approximately 2,100 miles of perennial and 1,200 miles of intermittent rivers and streams. The majority of these perennial streams are designated by the Michigan Department of Natural Resources as coldwater trout streams. Four major rivers, including the Au Sable, Pine, Au Gres, and Tawas, are found within the Huron National Forest. Eight major rivers, including the Manistee, Little Manistee, Pine, Big Sable, Pere Marquette, Pentwater, Muskegon, and White Pine traverse the Manistee National Forest.

River basins may be divided into 5th level watersheds (about 40,000 to 250,000 acres in size). The HMNF are located within 30 different 5th level watersheds. Twelve watersheds of the Huron National Forest drain to Lake Huron, while 18 watersheds of the Manistee National Forest drain to Lake Michigan.

Lands comprising the HMNF contribute an estimated 1,200,000 acre-feet of water yearly to river systems (one acre-foot of water covers 1 acre with 12 inches of water).

Water Quality

Overall water quality of inland waters is good to excellent in the northern Lower Peninsula of Michigan, which includes the HMNF (Michigan Department of Environmental Quality, Water Division 2008). There are exceptions within HMNF boundaries. There are concerns with polychlorinated biphenyls (PCBs) in various water bodies; excessive nutrients; sedimentation; increasing numbers of aquatic nuisance species; highly physically-modified water systems; and statewide mercury advisories on inland lakes.

Point sources of pollution are regulated. Permitted discharge sites include landfills, power plants, and industry. Watersheds with the most point sources tend to occur around the cities of Muskegon, Baldwin, Cadillac, Manistee, and Tawas.

Non-point sources of water pollution include sediment, temperature, pesticides, nutrients (manure and fertilizers) and pathogens. Much of the Huron National Forest has relatively low potential for non-point pollution sources due to land ownership patterns. In contrast, much of the Manistee National Forest is highly susceptible to non-point pollution because of the intermingled land ownership pattern of agricultural and urban lands.

Groundwater quality is generally high on the HMNF.

Herbicides in Soil and Water Resources

Soil columns have been altered by oxides of sulfur and nitrogen via acid precipitation and, therefore, pH and nutrient balances are not pristine. It is unknown how much herbicide is used by the general public and agricultural users in the area. Pesticides have been applied by the Forest Service in accordance with labeling instructions, and by licensed applicators. Herbicides were used on the HMNF in the 1970s, for example, when applicators were not required to be licensed. Both land and aquatic pesticides are formulated so that they breakdown relatively quickly in the environment. Therefore, there should be little or no residual pesticide contamination from those herbicides listed in Table 2.5 within the land or waters that are managed by the Forest Service.

One comment received from the NEPA public scoping process stated application of herbicides to control NNIP will remain active in the soil and pose environmentally harmful effects. This issue is evaluated in Chapter 4.

3.3 LAND USE, RECREATION AND AESTHETICS

Land Use

Widespread clearcutting followed European settlement of the region; this was followed by hot slash fires and land clearing in the late 19th and early 20th centuries. During this settlement period, livestock husbandry and other agricultural practices were introduced to marginally productive lands, much of which was later abandoned. In addition, natural-occurring and human-caused wildfire was suppressed. Today, lands within the National Forests support predominantly second and third growth forest vegetation, range and agricultural uses, and small rural communities.

The proclamation boundaries of the Huron-Manistee National Forests encompass 2,021,090 acres. About half the land, 978,738 acres, are National Forest System lands. The other acres are owned and managed by private individuals or industries, or State, Tribal, and local governments. Principal land uses are housing, small business, outdoor recreation, wildlife habitat, agriculture and commodity production, especially lumber and wood fiber. The checkerboard pattern of land ownership influences introduction, spread, and potential treatment of non-native invasive plants. Many non-native invasive plants have historically been introduced to new areas as ornamental beauties in front yard landscapes or as herbs in the kitchen garden.

An estimated 10,400 miles of road exist within the Forests' boundaries, resulting in an average road density of 3.2 miles per square mile. Of these roads, approximately 6,997 miles, 67 percent, are two-lane improved roads and approximately 3,403 miles, 33 percent, are single-lane unimproved primitive or minimally improved travelways. Of the total miles, approximately 6,670 (64 percent) are State and County roads, and 3,730 (36 percent) are National Forest System roads. Final Environmental Impact Statement, pg. III-279; USDA Forest Service (2006d).

Recreation

In 2007, the Huron-Manistee National Forests had 174 developed recreation sites covering approximately 2,230 acres, which included campgrounds, beaches, picnic sites, boat launches, fishing sites, overlooks, interpretive sites, and trailheads. The Huron-Manistee National Forest transportation system included 10,400 miles of roads and 1600 miles of trails, providing access to 978,738 acres of National Forest System lands for hunting, fishing, recreation, sightseeing, and commodity production. The different types of trails included approximately 596 miles motorized trails, 640 miles snowmobile only trails, 180 miles hiking trails, 140 miles cross country skiing/hiking, 80 miles bicycle/hiking/cross country skiing, and 160 miles horse/hiking trail. Most trails have multiple types of users. Water-based recreation occurred on approximately 1,800 miles of rivers and 17,000 acres of lake (HMNF FEIS III-271). The main water-based recreation included swimming, fishing, motorized boating, and non-motorized boating. Each time a person, animal, or equipment passes through the Huron-Manistee National Forests they influence, intentionally or unintentionally, the introduction, spread, and potential treatment of non-native invasive plants

Aesthetics

Factors affecting aesthetics are ownership patterns, management practices, road distribution and frequency, and visitor activities. These same factors influence introduction, spread, and potential treatment of non-native invasive plants.

Historically, vegetation within the Huron-Manistee National Forests has been disturbed or altered; today, however, most National Forest System lands provide natural appearing views. During revision of the 2006 Forest Plan, approximately 9 percent of the Forests were inventoried as being "Semiprimitive" areas with natural or natural appearing views. Approximately 78 percent of the Forests were inventoried as "Roaded Natural" with views that were mosaic and predominantly natural appearing. Approximately 13 percent or the Forests were inventoried as "Rural" with modified landscapes and high ownership fragmentation intermixing forests, farms, and urban areas. Views in these Rural areas show predominantly human modification of the environment. USDA Forest Service (2006b).

3.4 AIR QUALITY

Air quality within the HMNF are considered to be generally good (Michigan Department of Environmental Quality 2006). Nevertheless, there are some concerns regarding air quality of the HMNF. Mercury deposition remains a problem over the HMNF and the Great Lakes Region (Michigan Department of Agriculture 2003).

Muskegon and Mason County portions of the Manistee National Forest have experienced an 8-hour non-attainment for ground level ozone (Environmental Protection Agency 2004). The ozone is associated with long-range transport and is not a result of forest management activities.

In 2006 the Houghton Lake air quality monitoring station recorded air quality as "good" for 240 days with 17 days recorded as "moderate: and no days as being "unhealthy for sensitives. The

Scottville station recorded 173 days of "good" air quality, 9 days at "moderate" and 2 days as "unhealthy for sensitives" (MDEQ, 2006).

Another air quality issue involves acid rain. However, these air pollutants originate from sources outside HMNF boundaries and cannot be controlled by the Forests' management activities. The mean pH (acidity) of rain as measured by the Forests' National Atmospheric Deposition Program station located in Wellston/Hoxeyville is 4.7; in 1986 the pH was 4.3. [Pure, "neutral" water measures pH 7.] The precipitation pH trend over HMNF are becoming less acidic; however, trends in various air pollutants (e.g., oxides of sulfur and nitrogen, and ozone) are not necessarily coincident.

3.5 CULTURAL ENVIRONMENT

Evidence of human occupation dates to nearly the end of the last ice age, approximately 11,000 years before present (BP). Numerous Cultural Resource sites have been identified, from a full range of time periods and regional cultural traditions. The National Historic Preservation Act (NHPA) of 1966, as amended, governs the process by which federal agencies identify, evaluate for significance, and consult with the State Historic Preservation Officer, Indian Tribes, and other interested parties in the management of historic properties.

Native American sites include extensive occupation areas as well as smaller resource gathering and special function locales. Euro- and non-Euro-American historic period resources include numerous 19th and early 20th century logging, home/farmsteads, mills, stores, schools, and CCC camps, among others.

It is possible (none have been identified) that the Forests support traditional cultural properties (TCPs). A TCP is defined generally as a property that is eligible for inclusion on the National Register because of its association with cultural practices or beliefs of a living community that:

1) are rooted in that community's history, and

2) are important in maintaining the continuing cultural identity of the community.

Federal and state agencies must ensure proposed actions do not destroy the integrity of possible TCPs or the context in which a community can function within its cultural tradition. Section 106 of NHPA directs federal agencies to consult with Native American organizations and knowledgeable individuals, who attach religious and cultural significance to TCPs.

3.6 SOCIOECONOMIC SETTING

The Huron National Forest's impact area is a nine county area including Alcona, Alpena, Crawford, Iosco, Montmorency, Ogemaw, Oscoda, Otsego, and Roscommon Counties. The impact area for the Manistee National Forest includes a nine county area including Lake, Manistee, Mason, Missaukee, Muskegon, Newaygo, Oceana, Osceola and Wexford Counties. Not all of these counties contain National Forest System land, but are included because of the Forests' influence on these counties.

Median household income (2000 data) of the Huron and Manistee impact areas is approximately $32,600 and $36,400, respectively. This is much lower than the state-wide average of $44,667. In 2000, unemployment in both areas was higher than state-wide rates. The Huron area averaged 8.1 percent and the Manistee area averaged 6.1 percent, while the State of Michigan averaged 5.5 percent unemployment (Michigan State University 2003).

Major local employment activity groups include manufacturing, trade, tourism, agriculture, and government. The local honey bee industry has concerns about potential affects by the proposed action in the next decade; however, local agriculture and Forestry (tree regeneration) could be affected as well.

Estimated total population of the Huron National Forest counties and Manistee National Forest counties are approximately 175,000 and 377,240, respectively. Population centers in the Huron impact area are: Alpena, Grayling, Harrisville, Mio, Oscoda, Tawas, and West Branch. Population centers in the Manistee impact area are: Baldwin, Cadillac, Ludington, Manistee, Muskegon, and White Cloud (Michigan State University 2003).

Chapter 4 ENVIRONMENTAL CONSEQUENCES

Chapter 4 evaluates potential impacts of the Proposed Action and Alternatives on resources described in Chapter 3. The general scope of environmental concerns for this project has been determined through the NEPA public scoping process. This analysis forms the scientific and analytic basis for the comparison of Alternatives in Section 4.9, considering the direct, indirect, and cumulative impacts on each resource.

Adverse and beneficial impacts are analyzed, as are short-term and long-term effects. As used in this document, the phrase short-term refers to an impact(s) that occurs during the timeframe in which an associated project action is underway. Similarly, “long-term” generally refers to impact(s) that persist or occur after an associated action has ceased.

As defined in 40 Code of Federal Regulations (CFR) 1508.7, a Cumulative Impact assessment presented in this chapter considers environmental effect: “…which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions.”

Because the majority of forest visitors come from Michigan, Illinois, Indiana and Ohio, those states were selected as the analysis area for the cumulative effects. Vehicles and visitors are the two primary vectors for the introduction of NNIP. Therefore, the cumulative effects analysis area will be the states of Michigan, Illinois, Indiana and Ohio. The proposed treatments are expected to have negligible effects beyond the HMNF boundary.

The temporal bounds of our cumulative effects analysis will be ten years because once treatment ceases infestation levels will continue to rise.

The cumulative effects assessment presented in this chapter considers the incremental evaluation of environmental effects of potential methods to control Non-Native Invasive Plant (NNIP) species on the Huron-Manistee National Forests (HMNF) when combined with the impacts of other similar or related activities (40 CFR 1508.28.7), in the reasonably foreseeable future.

Forest Service specialists representing applicable interdisciplinary environmental disciplines were consulted in assessing the cumulative impacts. Table 4-1 lists principal past, present, and reasonably foreseeable actions for each resource investigated in this chapter.

Table 4-1. List of Principal Past, Present, and Reasonably Foreseeable Actions that Could Affect Resources Described in Chapter 4.

Resource Issue	Principal Past, Present, and Reasonably Foreseeable Actions Affecting the Respective Resource
Biological resources	• Management activities, including recovery which is designed to protect species, particularly Endangered and Threatened species. Due to increased development and the proximity of more non-native ornamental plants near the Forests, it is expected infestation across the Forests will increase. More open lands are to be created on the Forests (prairies, barrens, savannahs) which could increase the likelihood of NNIP Spread by increasing habitat for these species. • Forest Service and recreational vehicles that carry and spread infestations of NNIP. NNIP can also be spread by other non-human activities (wind, birds, wildlife). Population and visitation of Forests are increasing, so we expect more opportunities for spreading NNIP from recreational vehicles. Road work by counties provides bare soil for NNIP infestation and some road seeding with non-native invasive species for ground cover. This is expected to continue. • Non-federal manual and mechanical weed control activities, such as mowing, have occurred in the past and are expected continue. • Herbicide applications to control weeds by public or private entities bordering or near the HMNF. Agricultural lands and herbicide applications associated with farming are declining, but herbicide from lawn treatments may be increasing due to more development. • Limited past use of herbicides by the Forest Service to control NNIP (administrative and recreation sites and campgrounds). Herbicide use for NNIP has occurred primarily on small patches of garlic mustard and purple loosestrife in administrative/recreation sites. In 2005 it was applied to stumps of autumn olive shrubs on one site; and in 2006 it was used on a 10 acre site to treat reed canary grass, on 2 sites for autumn olive, and at a wildflower sanctuary for several NNIP. Treatment levels are expected to increase slowly each year. • Use of manual and mechanical methods by the Forest Service to control NNIP. Since 2002 the Forests have treated approximately 200 acres to control NNIP, mostly by manual methods. It is expected that treatment levels will rise slowly on the Forests. When considering control efforts' effects on species diversity with the spread and introduction of NNIP, treatments will help to maintain a diversity of species that would decline without intervention. • Forest Service actions to control NNI plant species beyond that proposed in this document. It is expected that in 2008 a total of 200 acres will be treated and that this amount of total non-native invasive plant species treatment will slowly increase (at an estimated rate of 50-100 acres per year for the next few years.) • Use of biological agents by the Forest Service to control NNIP. Biocontrol There has seen limited use. Releases of Galerucella pusilla did not establish well in Michigan and subsequent releases

	have been limited to the beetle Galerucella calmariensis. Beetles have been released on 14 sites across the Forests. • Development of private land is increasing. That portion of land development that occupies building footprints and parking or other paved areas represents a general loss of native habitats. Those areas that make up the landscaping for developed areas are disturbed and provide increased habitat for spread of NNIP, leading to a decline in the populations of some native species in these areas. These areas may also be planted with non-native ornamental plants increasing the potential of spread of these species onto the Forests.
Soils, hydrology, and water quality	• Management practices that influence the productivity of public and private forest and non-forest lands, e.g., organic matter retention and preservation of nutrient cycling processes. • Agricultural and other manual and mechanical activities on private lands and in campgrounds and developed areas of HMNF contributing to sedimentation. • Non-point-source agricultural chemical runoff from private lands. Agricultural land declining, but herbicide from lawn treatments may increase.
Land use, recreation, and aesthetics	• Other federal/non-federal development and recreational activities. Planned recreational development such as boat launches, trailheads, and trails may increase visitation, leading to more introductions of NNIP. • Other federal/non-federal related Non-Native Invasive Plant (NNIP) control activities. Aquatic NNIP can reduce use of waters for boating, fishing and swimming. Some NNIP cause rashes and other skin reactions and are often found in recreational areas. This project will provide a vehicle to remedy such situations.
Air quality	• Emissions from power plants and industry. • Forest Service and private vehicular emissions. • Herbicide emissions from other government and private control activities that may use aerial spraying.
Cultural resources	• Other federal/non-federal related NNIP control activities. • Federal/non-federal land use and development activities. • Management activities designed to protect Cultural Resources.
Human health and safety	• Forest Service-sponsored herbicide applications within HMNF. • Public or private herbicide applications on areas bordering HMNF. Decline in agricultural land and agricultural herbicide treatments, but an increase in lawn applications. • Forest Service, contractor, and private pesticide spraying activities that might expose individuals to pesticide residues. • Traffic accidents, drowning, work place, and hand tool accidents.
Socioeconomics	• Other local and regional, Federal/non-Federal business and development activities, particularly those that that stimulate jobs or economic growth. • Future federal NNIP control activities on the HMNF. This proposal could create jobs for contractors or Forest staff. This would be a

	small increase. The treatment of NNIP on up to 2% of the NF system lands, with Conservation measures, including planting native nectar when the treatment would lead to a shortage of nectar in the area, may produce a temporary and limited loss of nectar producing plants. It would also be expected to provide some level of protection for native nectar producing plants. The timing of nectar production from the change in species composition would have a limited effect as it only would apply to up to 2% of the National Forest Lands and that 2% would be spread over the Forests in small patches. The diversity of nectar timing would be protected by providing a higher diversity of nectar producers across the Forests. Cumulatively loss of NNIP nectar producers would be considered with the loss of nectar from land use development and the overall increase of spread onto the Forest and open lands in the area. • Although not all targeted NNIP plants are considered nectar species, native nectar plant species could be planted following NNIP suppression. Considering other land use conversions and land uses (including the increase of NNIP on other lands), and the scale of this proposal, this effect for the honey bee industry is considered insignificant.

4.1 BIOLOGICAL ENVIRONMENT

An analysis of direct and indirect impacts to vegetation and natural habitats is provided in Section 4.1.1. Section 4.1.2 provides an evaluation of potential impacts to fish and wildlife. Potential effects on Federally-listed Endangered and Threatened species and Regional Forester Sensitive Species (RFSS) are evaluated in detail in a Biological Evaluation prepared to accompany this EA. The findings of the Biological Evaluation are summarized in Section 4.1.3.

Consistent with direction in 40 CFR 1508.8, the spatial scope of assessment of direct and indirect impacts on biological resources in Section 4.1 is confined to the HMNF proclamation boundary and adjacent lands, to which reasonably foreseeable impacts of proposed control actions might pose a potentially significant impact. The temporal scope of this analysis on biological resources spans the timeframe over which the proposal would run, and any additional reasonably foreseeable period required for these impacts to dissipate to a point that would not pose a potentially significant impact (40 CFR 1508.8).

Cumulative impact assessment of biological resources considers the scope of proposed actions, added to the impacts of other past, present, and reasonably foreseeable future activities. Specifically, the spatial scope of cumulative impact analysis of biological resources includes the HMNF proclamation boundary and adjacent properties where proposed control activities could potentially combine with other similar Federal or non-Federal activities to produce a significant impact. The temporal scope of this analysis of cumulative impacts upon biological resources spans the timeframe over which other similar Federal and/or non-Federal NNIP control activities may be conducted. It extends a reasonably foreseeable period following the end of this proposal, in which impacts of Forest Service control activities could potentially contribute to a significant impact when combined with the effects of other similar Federal or non-Federal activities (40 CFR 1508.7).

Chemical Control – Alternatives 2, 3 and 4

Some concern was raised during public scoping about the effect of removing autumn olive and black locust during NNIP control. The concern was that these plants fix nitrogen in the soil, making it more available as a plant nutrient, since nitrogen is often a limiting nutrient for plant growth. While that is sometimes the case, in many other cases other factors are limiting for plant growth. In the prevalent sandy soils on many areas of the HMNF, moisture is the limiting factor (M. Sands personal communication). Many native nitrogen-fixing shrubs such as *Alnus incana*, *Shepherdia canadensis*, *Ceanothus herbacea*, and *Comptonia peregrina* occur naturally. Extra nitrogen from prolifically expanding populations of NNIP nitrogen-fixing species may also contribute to soil changes that enhance further invasive plant establishment of additional exotic species. Recent studies also show that nitrogen leaching may occur into the watershed in areas where autumn olive occurs (Church et al. 2004) and could have water quality implications. Finally, it is not expected that the amount of autumn olive or black locust removed (from less than 0.2% of the HMNF per year) would have an overall impact to soil and resultant vegetation conditions on the Forests.

Biological Control – Alternatives 2, 3 and 4

Proposed biocontrol agents have been demonstrated through research and field tests to be highly specific to a narrow taxonomic range of plants that include only the target NNIP species and other species that are highly similar phylogenetically.

Proposed agents, including flies in the insect Order Diptera and beetles and weevils in the insect Order Coleoptera, would be released at only one or a few sites per infested area and would be allowed to spread gradually on their own. To the extent possible, release sites would be chosen at the edges of existing roads in upland habitats, at the upland edge of wetland habitats, or along the shore for milfoil weevils. The act of releasing biological control agents would have little potential for adverse effects to non-target plants or animals. Vehicles would utilize existing roads only. The agents would be hand carried from vehicles to release sites to minimize inadvertent trampling of non-target vegetation. Any physical disturbance caused by trampling of vegetation or by manually propelling boats through emergent or aquatic vegetation in order to release biological control agents would be brief and temporary.

4.1.1 Vegetation

Alternative 1

Under Alternative 1, control of NNIP species on the HMNF would continue as it has proceeded in the last few years. Treatment areas would be limited to NNIP infestation sites on administrative or recreation sites, or in large projects under separate NEPA analysis. Such large, timber, wildlife, reforestation, and fuels reduction projects would consider all natural resource needs including NNIP suppression.

Rapid response to minimize spread of newly discovered NNIP populations is a major goal of this Proposed Action. Alternative 1 would limit rapid treatment response except in administrative or recreation sites, since small populations of NNIP are allowed to be treated without separate NEPA analysis according to the Environmental Policy and Procedures Handbook, FSH 1909.15, chapter 31. This section lists categories for which a project or case file and decision memo are not required for project action. Specifically 31.1.b.(5) states that repair and maintenance actions for recreation sites and facilities that normally do not individually or cumulatively have a significant effect on the quality of the human environment, may be categorically excluded from documentation. Examples listed include 31.1.b.5.d: Applying registered pesticides for rodent or vegetation control.

NNIP infestations in other forested and non-forested areas could be analyzed separately for treatment; however the length of time to do analysis and implement treatment projects would be 9 months to 2 years or longer, depending upon the project being implemented. Lack of rapid response ability would result in more opportunities for NNIP to get a strong foothold in new areas of infestation. Natural dispersal of NNIP seed and other propagules would result in ever-increasing numbers of infestation sites. Responsibility for chemical control of lakes infested with Eurasian water-milfoil would be left to the Michigan DNR, lake associations, counties, or other interested parties. As under all Alternatives, invasive plant prevention and education efforts would continue as described in Chapter 1.

Uncontrolled spread of NNIP species into undeveloped areas of the HMNF would result in native plant species experiencing increased competition. The invasive character of NNIP species results from their ability to compete aggressively with other plants and replace the suite of naturally-occurring plant species with monotypic stands of exotics and reduced plant biodiversity. Invasive plant establishment is especially likely to occur in areas of disturbance such as wildfire, wind storms, insect outbreaks, or logging. It displaces native plants, thereby giving opportunistic NNIP species an opportunity to colonize disturbed areas before native species can reestablish (Myers and Bazely 2003). Therefore, failure to control NNIP infestations on the HMNF will eventually result in greater adverse impacts to native vegetation and natural biodiversity.

Public scoping raised a concern over removing nitrogen-fixing invasive plants. Under this Alternative, black locust and autumn olive would not be removed except for administrative/recreational site treatment and large NEPA project implementation. Soil chemistry would continue to be altered in areas where new and expanding populations of these NNIP species occur. Such chemical changes would result in likely changes in native plant composition and may favor establishment of additional NNIP species.

Alternative 2

The subsections described below separately address potential impacts from manual, mechanical, chemical, and biological control components of the Proposed Action.

<u>Manual or mechanical Control</u>: Most proposed manual or mechanical control of NNIP species would be by selective methods such as hand-pulling, cutting, or digging up individual plants. Control would be conducted in natural settings as well as along roadsides, recreation and administrative areas on the HMNF. Some NNIP plants would be selectively treated with the weed torch. These selective control methods would have little potential to disturb adjacent non-target plants. They could be conducted in forested areas without disturbing the tree canopy and with little disruption of desirable understory or groundcover vegetation. They could be conducted in wetlands and other areas of soft soils without entry by vehicles or heavy equipment capable of substantially compacting or rutting the soil surface. (see section 4.4.3 and the Biological Evaluation).

Removal of large invasive trees by cutting them down could have a short term impact on nearby vegetation from the actual felling and removal process. There could also be a short term change to the area by this action allowing more sunlight to reach the forest floor. Given the small amount of non-native trees in relation to the total acreage of the Huron-Manistee National Forests and also considering the long term ecological benefits of cutting down and removing small areas of non-native species such as Scots Pine or Tree-of-Heaven, far outweigh the short term negative effects on young oak reproduction, for example.

Nonselective manual or mechanical control methods such as mowing, plowing, disking, or blading would be largely limited to areas of previously disturbed soils such as roadsides, borrow pits, and developed areas such as campgrounds. Nonselective treatments would disturb all or most vegetation in the treated areas, not just the targeted NNIP species. Mowing would not kill plants, but would be done before flowering or seed dispersal to eliminate additional invasive plant seeds, or would be done to deplete NNIP plants' food reserves. Repeated mowing can help reduce plant vigor for some species. Plowing, disking, or blading would disturb root systems and kill some perennial as well as annual plants. However, some invasive species such as leafy spurge are able to form new plants from root fragments, and this type of treatment could result in an increase in invasive plant population size. Plowing, disking or blading generally would be done only in cases where native seeding would follow. Otherwise disturbed soil would most likely be recolonized by invasive species.

Chemical Control: Herbicides applied by spraying can contact and kill or injure non-target plants in treated areas. Hand application of herbicides to stumps, cut surfaces, or basal bark of woody plants has less potential for injury to adjoining non-target plants than backpack or handheld spraying. Spray drift, spray equipment leaks, and misdirected spray streams would be much less likely. These treatments therefore would be the preferred method for treating small infestations of woody plants such as buckthorns or honeysuckles in forested areas, although larger infestations might require less labor-intensive spray treatment.

Aquatic herbicide use poses the greatest risk to non-target plants, since direct application to target plants is not possible underwater. 2,4-D and triclopyr are selective herbicides that kill only dicot (broad-leaf) vascular plants such as milfoil (including Eurasian water-milfoil), coontail, yellow pondlily, white waterlily, water marigold, and bladderworts. Monocot plants such as pondweed (Potamogeton spp.), bur-reed, naiad, rushes, bulrushes, eel-grass, and elodea remain unharmed. Endothall is a broad spectrum herbicides to which all aquatic plants are susceptible. Aquatic herbicides would be applied only to water areas infested by Eurasian water-milfoil, which would allow the targeted milfoil to be suppressed or eradicated, followed by natural recovery of a native aquatic plant community (Getsinger et al. 1997, Parsons et al. 2001, Skogerboe and Getsinger 2002).

Biological Control: Some comments received following the scoping notice indicated that some members of the public were concerned about the potential for long-term adverse impacts caused by biological control agents feeding on non-target plants. While it is true that biological control agents proposed for use against purple loosestrife, leafy spurge, and spotted knapweed are not indigenous to the United States, all have extensive and successful records of prior use in the United States (Van Driesche et al. 2002). They have all been permitted for use in the United States by the U.S. Department of Agriculture, Animal and Plant Health Inspection Service (APHIS) under the Plant Protection Act of 2000 (7 USC 7701 et seq.). Before permitting the release of non-indigenous biological control agents, APHIS thoroughly evaluates the potential risk of adverse impacts to non-target plants and animals (USDA APHIS 2004a and 2004b).

Three insects proposed for targeting purple loosestrife (*Galerucella calmariensis*, *Galerucella pusilla*, and *Hylobius transversovittatus*) were introduced to North America in 1992. They were initially released in several northeastern and northwestern states with especially severe infestations of purple loosestrife and were subsequently released in several Midwestern states, including Michigan (Cornell University 2004). The Michigan Department of Natural Resources (MDNR) began releasing the two *Galerucella* beetles in 1994 and reported that the beetles were beginning to reduce purple loosestrife populations by 2001. As of 2001, the Michigan DNR expected to establish viable populations of the *Galerucella* beetles in 10 years in every Michigan watershed infested by purple loosestrife (Michigan Sea Grant 2001).

These insects feed preferentially on purple loosestrife, but also feed heavily on other plant species of the genus *Lythrum*, including other introduced species such as European wand loosestrife (*Lythrum virgatum*), hyssop-leaf loosestrife (*Lythrum hyssopifolia*) (Illinois Natural History Survey 1999). Galerucella beetles also have been reported to feed on other plants such as crepe myrtle (*Lagerstroemia indica*, an exotic tree), swamp dock (*Rumex verticillatus*, a native forb, not known to occur in the region), sandbar willow (Salix interior, a native shrub, known to occur on the HMNF), and several plants in the rose family. Damage is reported to be minor (Schooler et al. 2003, Kaufman and Landis 2000, Illinois Natural History Survey 1999). Releases of all three insects in Rhode Island from 1994 to 1996 effectively reduced stands of purple loosestrife while having minimal affects on botanically-related swamp loosestrife (*Decodon verticillatus*) a native forb (Tewksbury 2004). It is possible that introduction of proposed biocontrol insects to wetlands on the HMNF could result in long-term reductions in populations of a few native species, especially those botanically similar to purple loosestrife. But any reductions would be minor compared to the negative effects of uncontrolled loosestrife proliferation, or long-term benefits to native vegetation from controlling purple loosestrife.

Flea beetles of the genus *Aphthona*, including the two proposed biological control agents targeting leafy spurge, have a history of more than twenty years of use to control leafy spurge in western rangelands (Anderson et al. 1999). Quarantine testing has shown that *Aphthona* flea beetles are very host-specific and feed only on a narrow range of hosts restricted to the spurge family (USDA Team Leafy Spurge 2003). The only known non-target plants fed upon by the proposed beetles are in the subgenus *Esula* of genus *Euphorbia*, of which there are no native representatives in this region. A potential risk to the few native plants in the genus *Euphorbia* is, however, acknowledged (Cornell University 2004). Native *Euphorbia* in Michigan include flowering spurge (*Euphorbia corollata*), tinted woodland spurge (*E. commutata*), warty spurge (*E. spathulata*), milk-purslane (*E. maculata*), hairy spurge (*E. vermiculata*), eye-bane (E. nutans), ridge-seeded spurge (*E. glyptosperma*), and seaside spurge (*E. polygonifolia*) (Voss 1985). *Euphorbia commutata* is designated as a Michigan-Threatened species and is a member of the susceptible Subgenus *Esula*, but is only known from southern Michigan, where leafy spurge biocontrol is already in use. *Euphorbia polygonifolia* occurs on sandy beaches and dunes along the shore of Lakes Michigan and Huron as far north as the Straits of Mackinac, but is in a different subgenus so should be less susceptible. Both proposed flea-beetles are already in use in Wisconsin. None of these *Euphorbia* species are Federally-listed as Endangered, Threatened or Regional Forester Sensitive Species (RFSS) (see Biological Evaluation).

Urophora affinis and *Urophora quadrifasciata* are seed-head flies, native to Europe, approved for release in 1971 and 1988, respectively. Both have been released and become established in Michigan, to control spotted and diffuse knapweed. Female flies lay eggs in developing knapweed flower buds. Eggs hatch after 3-4 days, and larvae chew down through the floret into the ovaries. After about 8 days, the plant starts forming a gall, reaching its maximum size in another week. About 8-9 weeks later, the second generation of larvae pupate and emerge as adults that lay the over-wintering generation of eggs in other new knapweed seedheads. These flies are host-specific to the plant on which they were reared, and do not attack other native knapweeds, safflower (an economically important relative of knapweeds), or artichoke. These flies are most effective at controlling spotted knapweed in combination with root borers and other seed-feeding insects.

Knapweed root weevil (*Cyphocleonus achates*) was first introduced into the United States for knapweed control in 1988, and was introduced into Minnesota in 1994 and Indiana in 1996. The lesser knapweed flower weevil (*Larinus minutis*) was first introduced into the United States for knapweed control in 1991, and was introduced into Minnesota in 1994 and Indiana in 1996 (Story 2002). Both weevils have been approved recently for release in Wisconsin (Lambrecht, personal communication). Neither weevil has been released yet in Michigan. The plant host selectivity of these and other biological control insects targeting knapweeds have been tested on several native species botanically related to knapweeds. In general, attack by all of the insects in captivity was restricted to the genus *Centaurea*, and usually to the subgenus *Acrolophus*. There have been no reports of attack on non-target species by any of these insects since their release (Story 2002). No plants in the genus Centaurea are Federally-listed as Endangered, Threatened or Regional Forester Sensitive Species (RFSS) (see Biological Evaluation). All members of the genus are exotic in Michigan, and several species are invasive.

Milfoil weevil, the only proposed biological control agent targeting Eurasian water-milfoil, is native to the United States, including Michigan (Sheldon and Creed 1995), and its use therefore does not require a permit from APHIS. It is recognized as offering reduced risk to non-target vegetation and distinct logistical advantages over biological control agents introduced from other parts of the world (Sheldon and Creed 1995). Milfoil weevil feeds specifically on water-milfoil plants (*Myriophyllum* spp.). It traditionally fed on the native northern water-milfoil (*Myriophyllum sibiricum*) and began to feed on Eurasian water-milfoil once introduced (Cornell University 2004).

Introduction of milfoil weevil to waters presently free of the species could result in long-term suppression of any native northern water-milfoil populations as well as the targeted Eurasian water-milfoil. One rare water-milfoil species, Farwell's water-milfoil (*M. farwellii*), is known to occur on the HMNF.

The Forest Service does not propose any biological controls for treating St. John's Wort as part of this proposal.

Alternative 3

Direct and indirect impacts would generally be similar to those described for Alternative 2, but the amount of treated area will be less than that described for Alternative 2. Therefore, greater spread of existing NNIP infestations will occur, and fewer new infestations are likely to be treated in Alternative 3. The same precautions described for all treatments under Alternative 2 would still be taken under Alternative 3. Earlier discussion in Section 4.1 (Alternative 3), provides a relative comparison of the decreased acreage proposed for Alternative 3 compared to that of Alternative 4.

Alternative 4

Impacts for Alternative 4 would be the same as those discussed for Alternatives 2 and 3 with possible additional impacts from limited vehicle-mounted herbicide spray or wick device and five optional herbicides (aminopyralid, fluridone, imazapyr, and metsulfuron methyl) to implement the control NNIP infestations on the HMNF. The additional application method would involve using a rubber tire tractor, crawler tractor, or 4 wheel ATV all fitted with a boom spray or wick device. The additional application method would be used to address open field conditions where invasive species are competing with native pollinator nectar species. This alternative allows up to 40 acres/year being herbicide treated with a vehicle-mounted sprayer. This type of application is similar to food field crops, where grasses or forbs, or all existing vegetation are killed with herbicide, followed by seeding of desired plant species. This method of operation could kill target and non-target plants. Short-term loss of native plants due to herbicide spraying would be more than offset by long-term gains of reducing highly competitive invasive species. In most cases, herbicide would need to be applied several successive times to new NNIP germinating from NNIP seed in the seedbank. In addition, spot applications of herbicide would also need to follow after native plant re-establishment. Seeding after herbicide would be limited to Michigan native genotype plants most suited to the specific site conditions and appropriate to that geographic locality. Seeding would result in open savanna or prairie conditions with nectar-producing herbaceous plants and native grasses.

<u>Chemical Control:</u> The herbicides applied in Alternative 4 would be the same as those applied in Alternative 2, plus five optional ones, including aminopyralid, fluridone, imazapic, imazapyr, and metsulfuron methyl. The herbicide impacts described in Alternative 2 are the same regardless of the number of herbicides that could be used. The advantage is that by increasing the suite of herbicides from which to choose, we can more appropriately match a chemical to a target species to be controlled.

Specific purposes of the optional herbicides include the following:

- Aminopyralid is a selective systemic herbicide that has been developed for the control of broadleaf weeds.

- Fluridone is a selective systemic aquatic herbicide used to control primarily broad-leaved, submerged aquatic macrophyte species including Eurasian watermilfoil, curly-leaf pondweed as well as native pondweeds.

- Imazapic is a selective herbicide that is used primarily in and around populations of native, warm season grasses.

- Imazapyr is a selective herbicide that is used primarily in the control of hardwood trees and some species of grasses.

- Metsulfuron methyl is a selective pre-emergence and post-emergence sulfonyl urea herbicide used primarily to control many annual and perennial weeds and woody plants.

Cumulative Effects

The cumulative effects analysis area will be the states of Michigan, Illinois, Indiana and Ohio. The proposed treatments are expected to have negligible effects beyond the HMNF boundary.

Increases in human populations, second homes and associated land development, road construction and travel, and recreational uses are expected on private lands within the northern Lower Peninsula of Michigan (NLP). These activities will likely result in increased NNIP on private and public lands, due to transport of NNIP seeds or vegetative fragments on human clothing, recreational equipment, and vehicles. These activities are also related to soil disturbance, which is another factor directly related to NNIP establishment. Transport of new NNIP is most likely to occur during recreational visits from more heavily populated areas in southern Michigan, northern Indiana and Illinois and Ohio, which have larger established populations of NNIP.

Some NNIP treatment is expected to occur under auspices of the Michigan Department of Natural Resources, The Nature Conservancy, National Park Service, and private and public nature centers. Some NNIP treatment may occur to limited degrees by private property owners; however many species targeted as NNIP for natural areas and the Forest Service are not necessarily the same weedy species targeted by homeowners.

Regardless of which Alternative is implemented for this proposal, increases in NNIP are expected to occur on the Forests. NNIP infestation is one of the top factors having negative effects on native plant communities and rare plant populations. Competitive and allelopathic effects of NNIP on native plant communities are cumulative to the additional negative effects of loss of habitat due to land use changes, and ecotype-dependant factors such as wildfire suppression, which negatively affect savanna/prairie plant habitats. Loss of habitat from all these factors is expected to continue on private lands surrounding the Forests and in the Cumulative Impacts Area of Analysis. Implementation of Alternatives 2 through 4 would have a positive effect by reducing the effects of an expected trend for NNIP adverse impacts on the Forests' native vegetation. Alternatives 2 and 4 would provide the greatest positive effect for native Forest vegetation.

4.1.2 Fish and Wildlife

"Endangered," "Threatened," and "Proposed" refer to species covered by the Federal Endangered Species Act of 1973 (16 U.S.C. 1531-1544, 87 Stat. 884, as amended -- Public Law 93-205) and designated by USDI Fish and Wildlife Service. RFSS include plant and animal species identified by the Regional Forester for which population viability is a concern (FSM 2670.5). In the discussion below, Endangered, Threatened, Proposed, and Sensitive species are collectively referred to as ETS species.

Alternative 1

Taking No Action to control NNIP infestations would result in no immediate direct adverse impacts to wildlife or fish. However, failure to successfully control NNIP infestations would allow continued infestation and degradation of more and more areas of wildlife habitat. Aggressive NNIP species tend to replace native plants upon which wildlife depend for food and cover. For example, purple loosestrife can replace mixed stands of native wetland plants with dense stands of nearly impenetrable vegetation that are poorly suited as sources of food, cover, or nesting sites for native wetland wildlife such as ducks, geese, rails, bitterns, muskrats, frogs, toads, and turtles (Minnesota DNR 1992). Some butterfly species are reported to lay eggs on garlic mustard (a NNIP species infesting several forested areas on the HMNF) instead of normal native plant hosts; but unlike native hosts, garlic mustard does not support complete development of the butterflies (Nuzzo 2000). American robins (*Turdus migratorius*) are reported to experience greater nest predation when nesting in exotic buckthorn and honeysuckle shrubs (NNIP plant species already present in forested areas on the HMNF) than when nesting in native shrubs and trees (Schmidt and Whelan 1999). Eurasian water-milfoil, an aquatic NNIP species that threatens to infest many ponds, lakes, and rivers on the HMNF, is of lower value as a food source for waterfowl than the native aquatic plants it displaces. It also supports an inferior diversity and abundance of aquatic invertebrates that are fed upon by fish, and can deplete dissolved oxygen levels in aquatic ecosystems (EATM undated).

In general, fish and wildlife species having relatively specific habitat requirements are more susceptible to adverse effects from continued spread of NNIP species than are habitat generalists. For example, white-tailed deer, habitat generalists that favor edge habitats and disturbed areas conducive to many NNIP species, would be less susceptible than American bittern, whose specialized wetland habitats can be greatly altered by NNIP species such as purple loosestrife. In addition to American bittern, the BE notes several Sensitive birds and reptiles on the HMNF with specialized habitat requirements that could face future habitat shortages if NNIP species are not successfully controlled. Some examples of affected birds include Endangered Kirtland's warbler, which requires dense young jack pine stands; Endangered piping plover, which requires open sandy beaches; and Henslow's sparrow, bobolink, and upland sandpiper, which require perennial grassland prairie habitats. Potentially affected reptiles include wood turtle, which requires sandy and gravelly riverbanks, and eastern massasauga, which requires riparian and adjacent upland habitats.

Public scoping raised a concern over removing autumn olive because of the winter food benefit it provides to wildlife. Under this Alternative, black locust and autumn olive would not be removed except for administrative/recreational site treatment and large NEPA project implementation. Thus, the wildlife food benefits that autumn olive provides would remain.

Alternative 2

Effects common to all Control methods

Control and treatment of NNIS plants would decrease competition with native plant species. This would increase the potential of retaining native vegetation sources for wildlife. Regionally indigenous wildlife generally are adapted to depend upon regionally indigenous plant species as sources of food and cover. Plants introduced from other parts of the world, while possibly beneficial to wildlife in that part of the world, are typically of less value to wildlife in areas of introduction.

Under this Alternative, there would be a reduction in the amount of autumn olive fruit available as a food source for wildlife. About 30 bird species, including American robin, eastern bluebird, Swainson's and hermit thrushes, cedar waxwings, European starlings, northern cardinals, northern bobwhites, and ruffed grouse feed on the fruits. Raccoons, skunks, opossums, black bear, and white-tailed deer will also eat autumn olive fruit. Rabbits and voles will eat the bark in winter. However, autumn olive may crowd out native shrubs that mature fruit at the time of fall migration, depriving migratory birds of nourishing native fruits (Eastman 2003).

Studies suggest that given a choice between native plant fruit and autumn olive fruit, birds prefer native plants (Eastman 2003). Factors affecting choices birds make between invasive and native fruits are complex, vary with the suite of available choices, and depend on characteristics of both frugivores and fruits involved.

The Forests are actively encouraging existing populations of, and planting native fruit bearing shrubs such as Allegheny plum.

<u>Manual or mechanical Control:</u> Many proposed manual or mechanical weed treatments have the potential to disturb wildlife. Digging up or cutting down NNIP trees or shrubs such as ailanthus or exotic honeysuckles could remove or disturb bird nests or animal burrows. Noise from brush saws, mowers, or other mechanical equipment would temporarily disturb most wildlife within earshot. Such noise, even though brief, could startle wildlife, forcing it to temporarily evacuate areas while work is in progress. Less mobile wildlife could be physically injured or killed by people or equipment during weed treatments. Nonselective manual or mechanical control methods such as mowing, plowing, or disking would be limited to non-forested already-disturbed sites such as gravel pits, but could still alter the character of wildlife habitat in these areas.

Several Conservation Measures outlined in the Biological Evaluation, and several design criteria outlined in Table 2-3, would ensure protection of wildlife during implementation of manual or mechanical control methods. To protect nesting birds, thickets of invasive shrubs such as exotic honeysuckle and Japanese barberry would be treated only after August 1. Individual NNIP tree or shrub specimens could be treated at any time, providing inspection shows no nesting bird in or below the targeted tree/shrub. Known nests or dens of Endangered, Threatened, or Sensitive species will be protected from disturbance during their breeding season. Prior to any treatments, actions covered by this EA would be reviewed by wildlife biologists. Treatments would be designed to minimize effects to associated resources, and pre-project surveys would be conducted as part of environmental analysis. Activities would be performed carefully to avoid physical injury to less mobile wildlife or to nests or burrows. When work is conducted in areas containing nests or burrows of Endangered, Threatened or Sensitive wildlife, known locations would be flagged or marked during operations only.

<u>Chemical Control:</u> Fish and wildlife could be exposed dermally (absorbed through the skin) to herbicides by direct contact with herbicide spray streams or with recently treated foliage. Wildlife could be orally exposed to herbicides by ingesting treated foliage or insects or other prey in recently sprayed areas, or by drinking water from aquatically treated sites. Fish, such as mottled sculpin and brown trout, likewise could be exposed to herbicides in waters treated directly with herbicides, and could be exposed if herbicides were used in adjacent wetlands or transported into waterways by surface runoff. Hand application of herbicides to stumps or cut surfaces (cut and stump treatment) or basal bark (basal bark treatment) on woody plants has less potential than spraying for herbicide runoff or drift, and therefore would be utilized wherever possible in areas known to contain Endangered, Threatened or Sensitive wildlife.

Herbicide toxicity data are presented in Table A-6 for aquatic, avian, and terrestrial vertebrate and invertebrate species, and in Table A-8 for mammalian species. Data suggest that the herbicides proposed for use in terrestrial and wetland settings are generally safe to mammals, birds, and other wildlife, if used in accordance with the manufacturer's label. No proposed herbicides are cholinesterase inhibitors such as organophosphate or carbamate insecticides (or chemically related to such insecticides) that are highly toxic to wildlife, especially insects and other invertebrates. No proposed herbicides are chemically related to chlorinated hydrocarbon insecticides such as DDT that are highly persistent in the environment and known to cause eggshell thinning of raptors (birds of prey) such as bald eagles and ospreys.

LD50 (Lethal Dose50) represents the dose (amount supplied orally) to a test animal species in a controlled laboratory experiment that causes 50 percent of test animals to die within the specified contact time. LC50 (Lethal Concentration50) represents the concentration (chemical concentration in a medium such as water) that causes 50 percent of externally exposed test animals to die in a controlled laboratory experiment. For purposes of comparison with mammalian toxicity metrics in Table A-8, the oral LD50 for rats exposed to table salt (sodium chloride) in their diet is reported at 3,000 milligrams per kilogram (mg/kg) body weight (Mallinckrodt Baker Inc. 2004). The oral LD50 for salt is somewhat higher (safer) than the oral rat LD50 values for most formulations of glyphosate and clopyralid, but not substantially greater (safer) than those for many of the other herbicide formulations. Table salt, a common substance with which everyone is familiar and which is generally regarded as safe except at very high concentrations, is often is used as a point of comparison for understanding toxicity data for pesticides. For purposes of comparing toxicities citied in Table A-6, the reported 48-hour LC50 for *Daphnia pulex* (water-flea) exposed to table salt is 1,470 milligrams per liter (mg/L) (Salt Institute 2004). This comparison value of table salt is actually lower (less safe) than the corresponding values for most herbicide formulations reported in the table. LD50 and LC50 values for many herbicide formulations do not differ greatly from this value.

Particularly noteworthy in Table A-6 are extremely low LC50 values (9.4 mg Acid Equivalent/L) for aquatic species exposed to the Roundup formulation of glyphosate, primarily due to its surfactant component. For this reason, the Roundup formulation is not labeled for use in aquatic areas, and would not be used in wetlands or riparian areas on the HMNF. Instead, the Rodeo formulation (without surfactant) would be used when treatment benefits of glyphosate are needed in aquatic or wetland settings. Aquatic species LC50 values for Rodeo are substantially safer (5,407 mg Acid Equivalent/L), and the Rodeo formulation is labeled for use in aquatic areas.

Only herbicide formulations registered for aquatic use would be applied in aquatic settings or wetlands defined in Cowardin, et al 1979 and the National Wetland Inventory (USDI Fish & Wildlife Service).

Aquatic species such as amphibians, fish, invertebrates and wetland plants and animals differ from terrestrial organisms in their sensitivity to herbicides. Larval stages of amphibians are more sensitive than embryos to teratogenic and developmental toxicants, and amphibian tadpoles are more sensitive than adults to herbicides or surfactants. Common effects of herbicides on amphibians, beyond direct mortality, include (temporary or permanent) paralysis, and alterations of behavior, development, and morphology (Berrill et al. 1993; Harfenist et al. 1989) Chemical cues emitted by predators also stress amphibians, and make herbicides more deadly where predators are present (Relyea 2005). Herbicide effects on fish can be directly lethal, or indirect, as when treatment of aquatic plant growth affects water transparency, biological oxygen demand, and dissolved oxygen, contributing to fish suffocation.

Substantial declines in populations of several amphibian species, including several habitat generalists that occur on the HMNF, have been documented (DAPTF 2003). One suspected cause of widespread amphibian population declines is increased use of pesticides, including but not limited to herbicides (Bury et al. 2004). Other suspected causes of amphibian decline include physical disturbance of wetlands; impacts to wetlands and other habitats from timber harvest and forest management; introduction of non-native predators such as sportfish and bullfrogs; acid precipitation; increased ultraviolet radiation; and diseases resulting from decreased immune system function (Bury et al. 2004).

Proposed herbicides would be applied carefully, following manufacturer's label instructions, Forest Service Manual direction, and the design criteria outlined in Table 2-3, thereby minimizing the potential for inadvertent exposure of amphibians to spray streams. No NNIP control activities proposed as part of Alternative 2 would contribute to loss or degradation of wetlands or other amphibian habitats, or to other factors suspected of contributing to amphibian decline.

<u>Biological Control:</u> Fish and wildlife are expected to benefit from use of biological control agents. As noted for vegetation, proposed agents have been demonstrated through research to adversely affect only targeted NNIP species or other very closely related taxa. It is therefore unlikely that native plants upon which wildlife depend for food or cover would be adversely affected. Regionally indigenous wildlife generally are adapted to depend upon regionally indigenous plant species as sources of food and cover. Plants introduced from other parts of the world, while possibly beneficial to wildlife in that part of the world, are typically of less value to wildlife in areas of introduction. For example, purple loosestrife, which could rapidly infest thousands of acres of wetlands on the HMNF if not successfully controlled, is regarded as low value food and cover for wildlife, compared to most wetland plants native to the eastern United States (Thunhorst 1993). Introductions of biological control agents targeting purple loosestrife would therefore be expected to reduce dominance by purple loosestrife and open infested areas to greater dominance by native plants of greater value as food and cover for wildlife.

Alternative 3

Impacts would generally be as described for Alternative 2, but with less area treated, and subsequently less potential effect. There would be less use of broader-scale, less selective treatments such as mowing or roadside spraying. The same precautions described for all treatments under Alternative 2 would still be taken under Alternative 3.

Alternative 4

Alternative 4 would be the same as Alternative 2, with the addition of limited use of vehicle-mounted herbicide spray or wick device and five optional herbicides (aminopyralid, fluridone, imazapic, imazapyr, and metsulfuron methyl) to implement the control NNIP infestations on the HMNF. Impacts from manual, mechanical and chemical control methods would generally be similar to or bounded by those described for Alternative 2. While some areas that might be treated by manual application under Alternatives 2 or 3 might instead be treated by more efficient vehicle-mounted herbicide application under Alternative 4, the affects on wildlife should still be minimal, as described for manual, mechanical and chemical control methods for Alternative 2.

Under Alternative 4, use of vehicle-mounted spray or wick device could result in more cost-effective and efficient control of NNIP especially in Karner Blue Butterfly restoration areas, and perhaps better survival of planted native vegetation in the first year. This alternative could also result in less vegetative diversity and decreased native wildlife food and cover initially after spraying, until replanted native pollen plants re-establish. This effect would be minimized by the 40 acre per year limitation on this form of treatment.

Herbicides being added, in addition to those already mentioned under Alternative 2, include: aminopyralid, fluridone, imazapic, imazapyr, and metsulfuron methyl. Toxicities of the additional herbicides fall within the range of herbicides originally proposed in alternative 2. Data suggest that herbicides proposed for use in terrestrial and wetland settings are generally safe to mammals, birds, and other wildlife, if used in accordance with the manufacturer's label. Fluridone has a relatively low LC50 for aquatic species and could be moderately toxic to fish and water fleas if used in aquatic habitats. Other sources give fluridone a slight toxicity to fish. Toxicological data on imazapyr's effects on insects, fish and birds are limited.

Cumulative Effects

Since vegetation harbors and feeds wildlife, the cumulative effects of these actions upon wildlife would be similar to those described for Vegetation in 4.1.1. Implementation of Alternatives 2 through 4 would have a positive effect in reducing effects of an expected increasing trend for adverse NNIP impacts on wildlife, especially E, T and S species in the Forests. As a result of project design criteria, herbicide impact on non-target species would be relatively small. Alternatives 4, and then 2, would provide the greatest positive effect for the Forests' wildlife, most efficiently and effectively.

4.1.3 Honey bees and Other Insects

Alternative 1

Many regionally indigenous insect species would benefit from successful control of NNIP infestations. The Biological Evaluation addresses several Sensitive insect species requiring specialized habitats composed of native plant species susceptible to invasion by NNIP species. Examples include Federally-listed Endangered Karner blue butterfly, which requires perennial grasslands or barrens dominated by wild lupine; Michigan bog grasshopper, which requires bogs dominated by leatherleaf and Labrador tea; and dusted skipper and ottoe skipper, which require perennial grasslands. Grassland habitats required by Karner blue butterfly and the two skipper species are remnant prairie habitats, historically maintained by natural fire cycles that have been suppressed, and presently dependent on controlled burning. Infestation of these habitats by NNIP species, especially woody species such as ailanthus and honeysuckles, hastens succession to unsuitable scrub cover and makes controlled burning more difficult. Dr. Douglas Tallamy (2007) addresses the impacts of NNIP on birds, noting, "…the foliage of autumn olive is inedible for almost all native insect herbivores. A field rich in goldenrod, Joe-Pye weed, boneset, milkweed, black-eyed Susan, and dozens of other productive perennials supplies copious amounts of insect biomass for birds to rear their young. After it has been invaded by autumn or Russian olive, that same field is virtually sterile."

Introduced, non-native honey bees of commercial importance use many native as well as introduced plants as nectar sources. Some targeted NNIP species infesting fields and roadsides on the HMNF, such as spotted knapweed, purple loosestrife, and white and yellow sweet clover, may provide nectar sources for honey bees. However, NNIP species can also displace native plants such as milkweeds, goldenrods, asters, eupatoriums, and lupines that are also good nectar sources in fields and roadsides on the HMNF. NNIP infestation is not thought to be a key factor in colony collapse disorder (CCD) of honey bees (USDA 2007; Calderone 2007). Therefore, taking No Action to control NNIP species on the HMNF would likely have little or no positive effect, and potentially some adverse effect on regional honey bee populations.

Alternative 2

As described for Alternative 1, NNIP infestation is not thought to be a key factor in colony collapse disorder (CCD) of honey bees (USDA 2007; Calderone 2007). However, habitat loss is suspected to be a contributing factor to declines in populations of many native bee species (in genera other than Apis, introduced honey bees) that provide pollination benefits to native plants and to agriculture (USDA 2007). NNIP control provided by Alternative 2 could therefore indirectly benefit populations of native pollinating insects. Such native pollinators could become of greater agricultural importance in the surrounding region if CCD causes regional introduced honey bee populations to decline.

<u>Manual or mechanical Control:</u> Adults of most insect species are capable of flight and thus not likely to be injured or trampled during manual or mechanical control activities. However, less mobile life stages (instars) such as eggs, larvae, nymphs, and pupae are susceptible to trampling or other physical injury by personnel or equipment during manual or mechanical treatment.

Losses of a few individuals of common insect species would not substantially affect regional population levels. The Biological Evaluation outlines measures that would be taken during manual or mechanical control activities to prevent losses to sensitive life stages of specific ETS insect species such as Federally-listed Endangered Karner blue butterfly and RFSS Michigan bog grasshopper, and dusted and ottoe skippers.

Manual or mechanical control measures are unlikely to directly kill honey bees. Swarming worker bees would readily fly away to escape personnel or equipment. Workers would be instructed to avoid areas with honey bee hives, where less mobile eggs, larvae, and pupae reside. As noted for Alternative 1, honey bees use many native as well as introduced plants as nectar sources. Therefore, successfully controlling NNIP species on the HMNF would likely have little or no adverse effect, and potentially positive effects, on regional honey bee and native insect pollinator populations.

Chemical Control: Although no proposed herbicides are considered to be insecticidal, toxicity data for terrestrial invertebrates in Table A-6 and ecological risk information in Table A-7 suggest that 2,4-D and dicamba could adversely affect honey bees and pollinating insects inadvertently exposed to those herbicides. The contact LD50 of 2,4-D to honey bees is >100 µg/bee, and values greater than 11 µg/bee are considered “practically non-toxic” by EPA. Other herbicides pose little risk when used at average FS rates (no information is available on endothall toxicity to insects, but it is applied directly to water and therefore honey bees and most pollinating insects are not typically exposed). However, careful effort to direct spray streams directly at target vegetation and to minimize drift and runoff of herbicides should minimize exposure of honey bee and pollinator populations to 2,4-D and dicamba.

Biological Control: Releasing proposed biological control agents would have little potential effects on honey bees or other insects.

Native insects are expected to benefit from NNIP control provided by proposed biological control agents. As described in the Biological Evaluation, many ETS native insect species on the HMNF such as Karner blue butterfly, Michigan bog grasshopper, and dusted and ottoe skippers depend on native vegetation that can be compromised by NNIP infestations. Many other native insects are adapted to native vegetation on the HMNF, and it is not known how well they would adapt to NNIP vegetation, especially expansive monocultures of NNIP species with low plant diversity.

Alternative 3

Impacts would generally be as described for Alternative 2, but with less area treated and subsequently less potential effect. There would be less use of broader-scale, less selective treatments such as mowing. Precautions described for all treatments under Alternative 2 would still be taken under Alternative 3.

Alternative 4

Alternative 4 would be the same as Alternative 2, with the exception that vehicle-mounted herbicide spray or wick device could be employed to limited acres and five optional herbicides (aminopyralid, fluridone, imazapic, imazapyr, and metsulfuron methyl) to implement the control of NNIP infestations on the HMNF. Impacts from manual, mechanical and chemical control methods would generally be similar to or bounded by those described for Alternative 2. The effects of herbicide application would be similar to that described in Alternative 2, however a larger volume of herbicide could be applied than in hand or backpack spraying, and it is likely that a greater number of insects would be inadvertently sprayed in broadscale application sites, limited to 40 acres per year.

Herbicide spraying is restricted in current KBB habitat and would have to follow strict control guidelines as spelled out in the Biological Evaluation.

For honeybees, clopyralid, dicamba, endothall, FAS, glyphosate, sethoxydim, and triclopyr are nontoxic (Table A-6; http://www.fs.fed.us/foresthealth/pesticide/risk.shtml).

While 2,4-D is not likely to cause mortality among honey bees at any of the application rates employed by the Forest Service (USDA Forest Service 2006a), moderate doses of 2,4-D severely impaired honeybee's brood production. The honeybee LD50 is 0.0115 mg/bee for 2,4-D (Extoxnet, 1996). Mortality would be highly improbable using ground based equipment and accepted operating procedures. Herbicide drift would be negligible with application of the herbicide when wind speeds are less than 10 mph (Table 2-3 Project Design Criteria), or according to label direction, to minimize herbicide drift.

Since such a small amount of acreage (0.02%/year) and only priority habitats or priority sources of NNIP spread would be treated, NNIP species would certainly continue their presence and would likely increase across the HMNF, even with treatment under this Alternative. Therefore, NNIP nectar plants and the local honey bee industry would not likely be appreciably affected by this small scale NNIP control project.

Cumulative Effects

Vegetation harbors and feeds honeybees and other insect pollinators, so cumulative effects of these actions upon honeybees and other insect pollinators would be similar to those described for Vegetation in 4.1.1. Implementation of Alternatives 2 through 4 would have a positive effect in reducing effects of an expected increasing trend for adverse NNIP impacts on honeybees and other insect pollinators. As a result of project design criteria, herbicide impact on non-target species would be relatively small. At most 0.02% of the Forests might be treated to control NNIP in any year. Only a fraction of those NNIP provide pollen for these insects, and other pollen sources are present or prevalent in most locations. Thus cumulative effects of these actions, in addition to effects beyond our control, is insignificant or discountable for honeybee and other insect pollinator populations. Alternatives 4, and then 2, would provide the greatest long-term positive effect for honeybees and other insect pollinators, most efficiently and effectively.

4.1.4 Endangered, Threatened and Sensitive Species

A Biological Evaluation (BE) has been prepared for this project by Forest Service biologists. The BE addresses potential effects of the four Alternatives on 5 Federally-listed fauna and flora species, as well as all Regional Forested Sensitive Species (RFSS) occurring in various habitats on the HMNF. The BE reviews all Forest Service planned, funded, executed, or permitted programs, projects and activities for possible effects on Endangered, Threatened, Proposed, or Sensitive species (FSM 2672.4). "Endangered," "Threatened," and "Proposed" refer to species covered by the Federal Endangered Species Act of 1973 (16 U.S.C. 1531-1544, 87 Stat. 884, as amended -- Public Law 93-205) and designated by USDI Fish and Wildlife Service. RFSS include plant and animal species identified by the Regional Forester for which population viability is a concern (FSM 2670.5). In the discussion below, Endangered, Threatened, Proposed, and Sensitive species are collectively referred to as ETS species.

Tables A-9 through A-12 present outcome determinations for each ETS species known to occur on the HMNF. Table A-9 presents determinations for Federally-listed species. Table A-10 shows determinations of potential impacts to RFSS aquatic species by habitat. Table A-11 presents determinations of potential impacts to RFSS plant species in each habitat. Determinations of potential impacts to RFSS wildlife in each habitat are presented in Table A-12. The accompanying Biological Evaluation contains more specific information.

Alternative 1

Taking No Action to control NNIP infestations would not directly result in adverse impacts to ETS species. However, the BE describes how failure to control NNIP infestations could result in increased competition experienced by Sensitive plants and decreased habitat quality for Sensitive fish and wildlife. Federally-listed Pitcher's thistle requires sandy dune habitat that is limited to increasingly scarce undeveloped coastal habitat. Infestation of only a small area of limited remaining coastal dune habitat by dense monocultures of NNIP species such as phragmites could jeopardize the future existence of Pitcher's thistle. The BE therefore concludes that failure to successfully control NNIP species (as would occur under Alternative 1) May Affect and Is Likely to Adversely Affect (MA-ILAA) populations of Pitcher's thistle.

KBB and Pitcher's thistle depend on the continued availability of highly specialized habitats whose spatial extent is not extensive on the HMNF or elsewhere on the Lower Peninsula and that are readily susceptible to severe alteration by one or more NNIP species. The BE (see sections 5.1.4 and 5.1.5) therefore concludes that Alternative 1 is likely to adversely affect (MA-ILAA) KBB and Pitcher's thistle.

The BE concludes that that failure to successfully control NNIP species (as would occur under Alternative 1) May Impact individuals of other Sensitive plants on the HMNF but is Not likely to cause a Trend toward federal listing or loss of viability (MINT) at least in the short term. It must be acknowledged, however, that unchecked spread of NNIP infestations over ever-greater areas of many habitats, especially habitats of limited distribution (such as coastal beaches, dunes, prairie grassland remnants and wetlands), could push some Sensitive plant species close enough to extinction in the long term to eventually warrant Federal listing. Sensitive plants specific to shallow water aquatic habitats, such as lake cress or waterthread pondweed, can be adversely affected by invasion of those habitats by NNIP species such as Eurasian water-milfoil and purple loosestrife. Sensitive plants specific to seasonally saturated and inundated wetlands, such as Torrey's bulrush (of marshes) and purple false-foxglove (of wet-mesic prairies and meadows), can be adversely affected by invasion of those habitats by NNIP species such as purple loosestrife and reed canarygrass, as well as encroachment into drier margins of wetland habitats by NNIP shrubs such as non-native buckthorns and honeysuckles.

These latter species also can invade forested wetland habitats required by species such as small round-leaf orchids of cedar swamps, and ram's head lady-slipper of swamps. Sensitive plants inhabiting understories of mesic and upland forests are also subject to adverse affects from continued invasion by upland NNIP species such as garlic mustard and Japanese barberry. Examples include lily-leaved twayblade (of sub-irrigated moist forest and thicket) and moonwort (of clay-loam forest and rich mesic hardwood forest).

Many ETS wildlife species addressed in the BE also can be affected adversely by NNIP infestation of their habitats. Examples include Federally-listed Karner blue butterfly and RFSS dusted and ottoe skippers, which are dependent upon remnant prairie grasslands susceptible to NNIP infestation. For such species, the BE concludes that failure to successfully control NNIP species (as would occur under Alternative 1) may adversely affect individuals of other Sensitive plants on the HMNF but not, at least in the short term, contribute to a trend toward Federal listing. However, not all assessed Sensitive wildlife species are sensitive to habitat infestation by NNIP species. For example, red-headed and black-backed woodpeckers (both RFSS) are dependent upon continued availability of dead tree trunks, irrespective of presence or absence of NNIP species. For such species, the BE concludes that Alternative 1 would have no impact (NI).

Alternative 2

<u>Manual or mechanical Control:</u> The BE describes how human activity and noise associated with manual or mechanical control treatments could adversely affect individual ETS species. Of particular concern are potentials for disturbance of Federally-listed Endangered Kirtland's warbler and Sensitive birds' nesting activities, and inadvertent trampling or mechanical disturbance of Sensitive plants or relatively immobile faunal life stages (such as reptile young and insect larvae). Conservation Measures outlined in the BE emphasize treatment timing restrictions for some threatened and endangered species, surveying and marking locations of sensitive species or their nests while treating an area, as well as training personnel to avoid marked locations and to recognize any sensitive species potentially present.

<u>Chemical Control:</u> The BE describes how proposed herbicides are generally of low toxicity to fish and wildlife. However, as described in the BE, some herbicides are either non-selective or at best broadly selective, affecting categories of plants similarly (e.g., all broadleaf herbs or all grasses). In general, sensitive plants exposed to herbicides could be killed or injured. Conservation measures such as those listed for manual and mechanical treatments above as well as adherence to herbicide label and Forest-wide Standard and Guidelines as well as Forest Service Manual direction would reduce risks of herbicide applications.

<u>Biological Control:</u> Use of proposed biological control agents is not expected to adversely affect any ETS species currently identified on the HMNF.

The BE included a finding of May Affect Not Likely to Adversely Affect (MA NLAA) for all 5 of the federally listed species. For all of the Regional Forester Sensitive Species Alternative 2 had a finding of May Impact Individuals but Not Likely to Cause a Trend toward Listing (MINT).

Alternative 3

The BE notes that impacts would generally be less than that described for Alternative 2, as long as the same Conservation Measures are taken to prevent exposure of ETS species to mechanical disturbance or to herbicides. The BE assigns the same determinations for each ETS species under Alternative 3 that it does under Alternative 2.

Alternative 4

Alternative 4 would be the same as Alternative 2, with the exception that vehicle-mounted herbicide spray or wick device would be employed to limited acres and five optional herbicides (aminopyralid, fluridone, imazapic, imazapyr, and metsulfuron methyl) to implement the control of NNIP infestations on the HMNF.

The BE notes that because manual, mechanical, chemical, and biological control components of the proposed program would result in little or no direct adverse impacts to ETS species, potential impacts from Alternative 4 would generally be similar to those from Alternative 2. The BE assigns the same determinations for each ETS species under Alternative 4 that it does under Alternative 2. Issues of concern, including environmental and health risks of chemical herbicide use, effects of control methods on non-target plants, and invasive plants threatening native plant communities, as well as the viability of rare plant populations, will not be compromised.

Effects of this mechanized equipment would be similar to the effects of mechanical treatment listed above. Herbicide application would be as disclosed above, except that this treatment would be non-target specific, so there could be a greater risk of direct exposure to KBB life stages. This treatment method in areas scheduled for seeding for Karner blue butterfly habitat would increase the likelihood of successful restoration of lupine and KBB habitat.

Cumulative Effects

Many factors contribute to biological impacts on the HMNF. These activities include:

- vegetation management;
- land management activities by private individuals and other agencies;
- habitat loss within species' range;
- impacts to populations due to recreation;
- habitat changes due to exotic earthworms, fire suppression, forest pests and disease, natural succession, wildlife herbivory and human collection;
- effects of climate change; and
- competition from invasive plants.

The proposed project seeks to address ongoing threats from NNIP species.

Under Alternative 1, there would be only limited efforts to control invasive plants on the HMNF. As discussed under Direct and Indirect Effects, existing infestations of several aggressive exotic plants would continue to spread, and fewer new infestations are likely to be treated. Anticipated and planned HMNF vegetation treatments, e.g., commercial timber sales, maintenance and construction of Forest and County roads that disturb soils, upland habitat management, and prescribed/wildfires that promote early seral species and NNIP populations are expected to impact over 145,000 acres during 2009-2018. In addition, similar activities on private lands within and adjacent to the HMNF are expected to occur at a rate similar to the past decade. Failure to control NNIP species on the HMNF, combined with failure of some adjacent private land owners to control NNIP species on their land (or to actually import them) could indirectly result in increasing regional dominance of NNIP species, with adverse cumulative effects on vegetation, wildlife, and ETS species.

Because effects of manual or mechanical control activities conducted as part of action Alternatives 2, 3 or 4 on Federally-listed or RFSS species are considered to be minimal, they would have little or no incremental effect when combined with impacts of other past, present, and reasonably foreseeable future activities listed above. Similarly, since effects of biological control activities on non-target biological species are considered to be minimal, they would have little or no incremental effect when combined with impacts of other past, present, and reasonably foreseeable future activities.

Under chemical treatment methods conducted as part of Alternatives 2, 3 or 4 proposed herbicides degrade rapidly in aquatic systems and exhibit low toxicity to fish and aquatic invertebrates, and do not bioaccumulate. As a result of project design criteria, herbicide impact on non-target species would be relatively small. Proposed herbicide treatments therefore would contribute only a marginal adverse incremental effect when combined with impacts of other past, present and reasonably foreseeable future activities. Consequently, herbicide use under Alternatives 2, 3 or 4 is not expected to result in a substantial increase in adverse cumulative effects to Federally-listed and RFSS species.

It is anticipated that proposed control methods described in Alternatives 2, 3 or 4 could result in stabilization, substantial reduction or eradication of NNIP species within treated areas. Proposed control methods complement efforts by other agencies and landowners to control noxious weeds and invasive species in Michigan. Cumulative benefits from controlling NNIP infestations would include protecting native species, including Federally-listed and RFSS species, and their habitats.

4.2 Soils, Hydrology, and Water Quality

Given impact assessment direction provided in 40 CFR 1508.8, spatial scope of the analysis of direct and indirect impacts on soils, hydrology, and water resources in Section 4.2 is confined to HMNF proclamation boundaries and adjacent lands to which reasonably foreseeable impacts of the proposed control action might pose a potentially significant impact. Temporal scope of this analysis of soils and water resources spans the timeframe over which the proposal would run and any additional reasonably foreseeable period required for these impacts to dissipate to a point that would not pose a potentially significant impact (40 CFR 1508.8).

Analysis of cumulative impacts considers the scope of proposed actions when added to impacts of other past, present, and reasonably foreseeable future activities and their effects on soils, geological, and hydrological resources. Specifically, the spatial scope of cumulative impact analysis on soil and water resources includes the HMNF proclamation boundaries and adjacent properties where the proposed control activities could potentially combine with other similar Federal or non-Federal activities to produce a significant impact. Temporal scope of this analysis on soil and water resources spans the timeframe over which other similar Federal or non-Federal NNIP control activities were first conducted. It extends to a reasonably foreseeable period following the end of this proposal in which impacts of Forest Service control activities could potentially contribute to a significant impact, when combined with effects of other similar Federal or non-Federal activities (40 CFR 1508.7).

4.2.1 Soils and Hydrology

Alternative 1

Under the No-Action Alternative, no actions would be taken to control NNIP infestations. This alternative will directly result in impacts to soil productivity by interrupting natural nutrient cycling processes. Over a period of time, NNIP infestations can adversely impact soils by removing nutrients and increasing soil erosion (Olson 1999). Invasion of wetlands by dense stands of purple loosestrife can alter hydrological flow patterns and evapotranspiration rates. Allelopathic chemicals (molecules produced by plants that harm other plants) released by certain exotic plants such as exotic buckthorns and barberries into the soil could inhibit the establishment of native plants. Therefore, taking No Action to control NNIP infestations will eventually result in some modest adverse impacts to soil and water resources.

Replacement of native vegetation by NNIP might have some effect on evapotranspiration rates; however, any hydrological effect is expected to be small and localized.

Alternative 2

Taking action to control NNIP infestations will have beneficial impacts, by reducing interruptions to biogeochemical cycling of nutrients. Loss of NNIP could have a nominal effect on evapotranspiration rates; however, most treated areas would be re-vegetated with native species. Proposed control methods are expected to have little measurable affect on hydrology.

Certain ground-disturbing control methods (such as smothering, blading, digging, plowing, or disking) could temporarily increase the potential for local scale soil erosion. Areas of soil left bare of vegetation following such treatment would be monitored for effectiveness and any need for revegetation to stabilize the soil until desired native species re-colonize the site.

Beyond providing a more effective method of controlling NNIP in some cases, use of biological control agents would have no measurable affect on soils or hydrology.

Herbicides kill but do not physically remove plants and their root systems. For this reason, herbicide use would not increase the potential for soil erosion. Dead plants would be expected to offer short-term soil stabilization to protect against erosion until new plants re-establish naturally. In those few instances where specific herbicides kill most of the targeted standing vegetation, effectiveness monitoring will include re-vegetation treatments to stabilize the soil. Treatments for those NNIP in the seed bank will require a combination of manual and chemical control methods to prevent them from re-establishing. Treating cut stumps of woody NNIP species (such as exotic buckthorns and honeysuckles) with herbicides would discourage re-sprouting without the soil disturbance required to physically grub the stumps out.

Herbicide applications inevitably result in the short-term accumulation of herbicide residues in soil. Herbicides can leach (migrate via water transport and gravity) into underlying soil layers. Surface runoff also can transport herbicides to unaffected soils, groundwater, or surface water bodies. To determine the level of risk for accumulation of herbicide residues in soils and possible contamination of ground and surface water, factors such as persistence (measured in half-life), mobility (ability of herbicide to be transported through soil), and mechanisms for degradation have been reviewed (Table A-4). Persistence of any herbicide is defined as the length of time that residues from an application remain active in soil. A concept known as half-life is commonly used to measure persistence, defined as the period of time it takes for 50 percent of an applied herbicide to degrade to a relatively harmless form byproducts. With half-lives of several weeks or less, herbicides proposed for use under this Alternative have short persistence in the soil; some proposed herbicides have half-lives as short as a few days. Soil microbes readily degrade each of the proposed herbicides. More persistent herbicides can offer longer suppression of invasive plants, including less re-establishment from existing seed in the soilbank.

Herbicide half-life data presented in this chapter are based on laboratory measurements. No data exist regarding half-life under field conditions specific to the HMNF. Conversely, some herbicides such as Roundup can be tied up in clays and organic matter, which effectively and permanently immobilizes these herbicide molecules from the biosphere. Therefore, some uncertainty exists regarding interactions between HMNF soils and herbicides. Nevertheless, any uncertainties regarding soil-herbicide interactions are not anticipated to substantially affect the conclusions of this analysis.

Factors influencing herbicide persistence include leaching potential, soil moisture content, soil and water acidity, amount of organic matter in the soil, organisms present, and molecular binding of chemicals to organic and soil particles. Precipitation patterns following application also heavily influence potential effects to soils, and potential contamination of groundwater and surface waters.

Soil mobility (movement through the soil) of proposed herbicides is varied (Table A-4). Glyphosate and ester formulations of triclopyr bind rapidly to the soil. Most formulations of 2,4-D, sethoxydim, FAS, and dicamba do not bind readily to the soil, and are rapidly degraded by soil microbes, light, or a combination of factors; they tend to have short half-lives of less than two weeks in soil. Clopyralid does not bind strongly to soil, and has a longer (approximately 40 days) half-life in soil, and thus, could leave longer-lasting residues in the soil. However, if proposed herbicides are used in accordance with label specifications, and design criteria outlined in Table 2-3, no long-term impacts to soils or geological resources are anticipated.

Alternative 3

The assessment of potential impacts for Alternative 2 also applies to Alternative 3, under which the same types of manual or mechanical treatments, herbicides, and biological control agents would be used. Because Alternative 3 involves decreased acreage of treatment (1,000 acres annually), the level of impacts anticipated will be less than those described for Alternative 2. While the gross area treated would be less than those described above, the time period over which these effects would persist would remain approximately the same.

Alternative 4

As described in Chapter 2, Alternative 4 is the same as Alternative 2, with the addition of vehicle-mounted herbicide spray or wick device employed on up to 40 acres annually and five optional herbicides (aminopyralid, fluridone, imazapic, imazapyr, and metsulfuron methyl) to implement the control of NNIP infestations on the HMNF. Use of a vehicle-mounted spray or wick device could increase the risk of worker accidents. In the unlikely event that precautions and Standards and Guidelines were not followed, increased use of chemical treatment methods could result in higher concentrations of herbicides that could contaminate soil and water-bodies, expose applicators, and enter the public food-chain.

Some leafy spurge or spotted knapweed infestation sites could be effectively treated by vehicle-mounted spray or wick device under Alternative 4. This could result in somewhat greater areas of soil disturbance and exposure of soils to herbicides, which would not otherwise occur under Alternatives 2 or 3. Effectiveness monitoring of vehicle-mounted chemical treatments will include re-vegetation treatments necessary to stabilize exposed soil until desired vegetation is re-established.

In addition, herbicides would be carefully directed at target plants, following project design criteria outlined in Table 2-3, preventing substantial exposure of soils to herbicide spray streams. Thus, any increased use of manual or mechanical or herbicide treatments resulting from vehicle-mounted sprayer use would result in only minimal adverse impacts to surrounding soils.

As discussed in Alternative 2, the amount of pesticide not washed off in runoff or sediment will penetrate into the soil column, and the depth of penetration will depend on the properties of the chemical, the properties of the soil, and the amount of rainfall. Plus, any pesticide can be transported from the soil at the application site by runoff, sediment loss, or percolation. However, if the optional herbicides are used (aminopyralid, fluridone, imazapic, imazapyr, and metsulfuron methyl) in accordance with label specifications, and design criteria outlined in Table 2-3, no long-term impacts to soils or geological resources are anticipated.

4.2.2 Water Quality

Alternative 1

Taking No Action to control NNIP infestations would have no direct measurable affect on water quality, except that spotted knapweed-infested areas might have higher runoff after rain.

Treatment measures taken to control NNIP species (especially species such as Eurasian water-milfoil and purple loosestrife that form dense uniform stands in shallow waters or wetlands) could help improve water quality over the long term. Although monocultures can stabilize soils and reduce sediment erosion, mixed stands of vegetation are generally less susceptible to rapid die-off that could suddenly leave large areas of unstable soil susceptible to erosion until new vegetation can reestablish. Therefore, taking No Action could indirectly increase some adverse long-term effects on water quality as a result of contamination or sediment erosion.

Alternative 2

Manual or mechanical treatment methods would have little potential to directly or indirectly affect water quality. Work performed in aquatic or wetland settings could temporarily erode sediment into nearby water bodies. However, considering the relatively small area that would be treated by manual or mechanical control methods each year (maximum of 2,000 acres annually, less than 0.02% of National Forest System lands in the HMNF), the effects generally would be brief and relatively localized. To help reduce any potential effects, mowers and other vehicles would not be operated in wetlands while the ground surface is inundated or saturated.

Use of biological control agents would have no measurable affect on water quality.

Chemical control methods involving spraying herbicides could expose soils and surface water to herbicides, even if performed according to label instructions. Herbicides that fall on soil during spray operations can be transported in surface runoff and leach into the underlying groundwater. However, considering the relatively small area that would be subject to treatment each year, proposed chemical treatment would not facilitate more than localized migration of small quantities of herbicides. Should herbicides enter surface water, their concentration would quickly decline because of mixing and dilution, volatilization, adhesion to suspended solids, and degradation by sunlight and microorganisms (van Es 1990). Furthermore, most herbicides proposed for use under Alternative 2 have relatively low toxicity to fish and aquatic invertebrate species, and have been demonstrated to pose little toxicological risk to fish and wildlife when used at rates typical for the Forest Service (Tables A-6 and A-7). However, certain formulations of 2,4-D and triclopyr are toxic to fish and aquatic invertebrates, and special precautions would be exercised during application to ensure that these herbicides do not affect aquatic resources.

Five herbicide formulations are approved for aquatic weed treatments: 2,4-D, endothall, fluridone, Imazapyr, and triclopyr. All five have been authorized for use against Eurasian water-milfoil in Michigan (Table A-2; Michigan Department of Environmental Quality 2007). Effectiveness of aquatic herbicides is predictable and is therefore the most common form of controlling Eurasian water-milfoil in areas too large to accommodate hand-pulling treatment (Skogerboe et al. 2003). All five herbicides are hazardous to humans if swallowed and pose various risks to aquatic plants and animals. Water quality can therefore be compromised when these herbicides are introduced. However, when applied to water, the herbicide is quickly diluted and degraded through biological activity. The State of Michigan and product labels set stringent restrictions on when treated water is considered safe, and specify setback distances from wells and water intakes (Table A-2). Effects to aquatic plants and animals from aquatic herbicides are discussed also in Section 4.1.

Although ecological risk assessment models of 2,4-D spills have shown them to result in substantial adverse impacts to fish and amphibians (USDA Forest Service 2006a), harmful spills are unlikely, considering the small amounts that would be used and the precautions described above. Herbicides would be prepared and mixed off-site or at a staging area located near the employee vehicle to prevent accidental spillage in natural habitats. Herbicides would be applied only by personnel licensed or under the supervision of licensed pesticide applicators in Michigan. Licensed pesticide applicators are trained to properly maintain application equipment to prevent leaks and to apply herbicide in a manner that minimizes drift. Furthermore, modern herbicides are designed to break down rapidly into inactive products in soils and water (see herbicide half-life data in Tables A-4 and A-5 and the discussion under Soils above).

Moreover, label directions would be followed to prevent or minimize any groundwater or surface water contamination from mobile chemicals. Herbicide treatment in riparian areas would follow label direction, specified protocols (Table 2-2) and project design criteria (Table 2-3) to protect aquatic resources. When used according to label specifications, no substantial long-term impacts to groundwater or surface waters are expected.

With the exception of some limited mercury contamination (principally from air emissions unrelated to this Proposed Action), water quality within the HMNF are generally considered to be relatively good (see Chapter 3 and Michigan Department of Environmental Quality (2006). None of the proposed herbicides contain, or are formulated with, mercury. This Alternative is therefore not expected to have any appreciable effect on mercury concentrations in streams or lakes.

Alternative 3

Assessment of potential Direct and Indirect impacts for Alternative 2 also applies to Alternative 3, under which the same types of manual, mechanical or herbicide treatments or biological control agents would be used. However, because of the smaller extent of treatments (1,000 acres annually), the magnitude of impacts described for Alternative 3 would be somewhat less than those described for Alternative 2. Any adverse impacts resulting from re-suspension of sediment or contamination of soils and water by herbicides would be brief and localized.

Alternative 4

Alternative 4 is the same as Alternative 2, with the addition that vehicle-mounted spray or wick device could be employed and five optional herbicides (aminopyralid, fluridone, imazapic, imazapyr, and metsulfuron methyl) to implement the control NNIP infestations on the HMNF. Because vehicle-mounted sprayers are so efficient, greater use of manual, mechanical, biological and chemical control methods may not be needed. Aquatic infestations of Eurasian water-milfoil or purple loosestrife would still be treated using biological or chemical control agents as in Alternatives 2 or 3. This should result in no greater potential for sedimentation of waters by manual or mechanical control methods or exposure of waters to herbicides, than in those Alternatives. However, design criteria outlined in Table 2-3 would ensure that wetland and aquatic habitats are not exposed substantially to sedimentation or herbicide spray streams under any Alternative. The herbicides being added, in addition to those already mentioned under Alternative 2, include: Aminopyralid, Fluridone, Imazapic, Imazapyr, and Metsulfuron methyl. By increasing the suite of selective herbicides from which to choose, we can more appropriately match a chemical to a target species to be controlled.

Cumulative Effects

Table 4-1 summarizes prominent past, present, and reasonably foreseeable future activities that can contribute to cumulative impacts on the HMNF. Under Alternative 1, there would be only limited efforts to control invasive plants on the HMNF. As discussed under Direct and Indirect Effects, existing infestations of several aggressive exotic plants would continue to spread, and fewer new infestations are likely to be treated. Anticipated and planned HMNF vegetation treatments, e.g. commercial timber sales, maintenance and construction of Forest and county roads that disturb soils, upland habitat management, and prescribed/wildfires that promote early seral species and NNIP populations are expected to treat over 145,000 acres during the period 2009 – 2018. In addition, similar activities on private lands within and adjacent to the HMNF are expected to occur at a rate similar to the past decade. Failure to control NNIP species on the HMNF, when combined with failure of some private land owners to control NNIP species on their land (or to intentionally import them) will result indirectly in increasing regional dominance of NNIP species, with adverse effects on vegetation, wildlife, and rare species. The manual or mechanical treatment methods proposed as part of Alternative 2 might result in some relatively short-term effects such as increased erosion and sedimentation in streams. However, they are not expected to contribute to any measurable increase in exposed soil or impaired hydrological conditions beyond that caused by commercial and non-commercial treatments on the 145,000 acres.

No additional or cumulative adverse effects would occur directly to soil and water resources as a result of the taking No new Action (Alternative 1); consequently, Alternative 1 would not contribute directly to any appreciable cumulative effects on these resources. Indirectly, it would allow infestations to persist and spread, worsening impacts on native vegetation, and causing adverse effects on runoff.

Under Alternative 2, only herbicides registered for aquatic use would be applied near or over open water or wetlands. Landowners have used herbicides on private land bordering the HMNF and can be expected to do so in the future. Past herbicides applications by the Forest Service have been applied in accordance with labeling instructions and by permitted applicators; under this proposal, the Forest Service would continue such applications, albeit under a limited and tightly controlled program; moreover, most treatment areas are anticipated to be relatively small in size.

Both land and aquatic pesticides are formulated so that they breakdown relatively quickly in the environment by natural processes, typically within weeks or several months, (Tables A-4 and A-5). Therefore, little or no residual herbicide contamination from past applications should substantially add to effects of the Proposed Action. Moreover, as herbicide effects from proposed activities are essentially small to negligible, they would have little or no incremental effect when combined with the impacts of other past, present, and reasonably foreseeable future herbicide use. Therefore, application of herbicides is not expected to result in any appreciable increase in cumulative herbicide concentrations in potentially-affected soil and water resources.

As discussed in Chapter 3, water quality problems in Michigan include elevated levels of mercury in streams and water bodies. However, proposed control activities under Alternative 2 would not affect cumulative mercury levels in streams or lakes.

Because total acres treated would be smaller under Alternative 3, (1,000 acres annually), cumulative impacts on soil or hydrological resources will be less than those described for Alternative 2. As impacts from proposed control activities are local in scale and minor in severity, they will contribute little or no incremental effect when combined with impacts of other past, present, and reasonably foreseeable future activities outlined in Table 4-1.

Since Alternative 4 is the same as Alternative 2 (with the addition of vehicle-mounted spray or wick device use on up to 40 acres per year and five optional herbicides (aminopyralid, fluridone, imazapic, imazapyr, and metsulfuron methyl) to implement the control NNIP infestations on the HMNF), use of herbicides and manual or mechanical control methods would be little increased and more efficiently applied, without creating additional incremental impacts. Cumulative effects would be similar to those described under Alternative 2.

Treatment measures under Alternatives 2, 3, and 4 would therefore contribute little or no incremental effect upon soils, hydrology, or water quality when combined with impacts of other past, present, and reasonably foreseeable future activities.

4.3 LAND USE, RECREATION, AND AESTHETICS

Based on regulatory direction provided in 40 CFR 1508.8, the spatial scope of assessment of Direct and Indirect impacts on land use, recreation, and aesthetics in Section 4.3 is confined to the Huron-Manistee National Forests' proclamation boundaries and adjacent lands to which reasonably foreseeable impacts of the Proposed control Action might pose a potentially significant impact. Temporal scope of this analysis on land use, recreation, and aesthetics spans the timeframe over which the proposal would run and any additional reasonably foreseeable period required for these impacts to dissipate to a point which would not pose a potentially significant impact (40 CFR 1508.8).

Assessment of cumulative impacts on land use, recreation, and aesthetics considers the type and duration of proposed activities when added to the impacts of other past, present, and reasonably foreseeable future activities. Specifically, the spatial scope of cumulative impact analysis on land use, recreation, and aesthetics includes the Huron-Manistee National Forests' proclamation boundaries and adjacent properties where proposed non-native invasive plant control activities could potentially combine with other similar Federal or non-Federal activities to produce a significant impact. Temporal scope of this analysis on land use, recreation, and aesthetics spans the timeframe over which other similar Federal or non-Federal non-native invasive plant control activities were first conducted. The temporal timeframe extends to a reasonably foreseeable period following the end of this proposal in which impacts of Forest Service control activities could potentially contribute to a significant impact when combined with effects of other similar Federal or non-Federal activities (40 CFR 1508.7).

Alternative 1

The Alternative of taking "No Action" to control non-native invasive plant would produce no immediate adverse effects on land use, recreation, and aesthetics. However, failure to control effectively the spread of non-native invasive plants could adversely affect future land use, recreation, and aesthetics.

The spread of dense stands of Eurasian water-milfoil, for example, could interfere with boating and fishing in infested lakes. Responsibility for chemical control of infested lakes would be left to the State, affected counties, lake associations, or other interested parties. Establishment of dense thickets of exotic buckthorns or honeysuckles could interfere with birding, hiking, and other recreation in forested areas. Spread of monocultures of visually striking species such as purple loosestrife could substantially alter natural aesthetics of some natural areas. Visitors visually experiencing typical landscapes may favor or disfavor the visible presence or dominance of exotic plants. Some non-native invasive plant species, particularly wild parsnip and giant hogweed, can cause dermatitis on exposed human skin. Continued expansion of such species would affect visitor safety and the aesthetic values of native landscapes on the Huron-Manistee National Forests.

Alternative 2

Manual or mechanical control activities would have little, if any, adverse impact on land use, recreation, or aesthetics. Manual digging of exotic vegetation would leave small areas of disturbed and exposed soil.

Herbicides, cutting, and pulling would generally leave cut or uprooted exotic plants on site to die. In some cases, such as with mature garlic mustard, plants would be bagged and removed. Weed torches could singe individual plants but would not visibly char areas of the landscape, as would a controlled burn.

Most treatment sites would be relatively small or located in relatively remote areas, and treatments would likely not be encountered by recreation visitors. Larger treatment areas could be more noticed when near recreation areas, private lands, roads, or trails. Regardless of short-term effects, natural succession and the growth of plants left behind, seeded, or planted would return treated areas to a more historically natural appearance. Temporary visual impacts such as small bare spots or browned or singed vegetation would generally be expected to last no longer than a single growing season, after which they would be obscured by naturally growing vegetation.

In most instances natural resource professionals, members of scientific communities and environmentally conscious individuals consider elimination of non-native invasive plant species as a benefit. However, some people, who may prefer the aesthetic appearance of non-native invasive plant over that of natural vegetation, might consider elimination of such species from the landscape as an aesthetically adverse impact. Some examples are purple loosestrife, which forms visually attractive masses of reddish-purple flowers in late summer, and honeysuckle shrubs, which bear attractive flowers in spring and red berries in fall. Nevertheless, restoring a diverse mix of native plant species that replaces near-monocultures of exotic plants outweighs any potential adverse effects to aesthetics.

Manual or mechanical control measures may interfere with developed and dispersed recreation activities for short periods of time. Methods that disturb the ground such as mowing, blading, or disking could temporarily alter the physical appearance of treated areas. Such activities, however, would be focused largely on NNIP areas of prior physical disturbance such as roadsides, former borrow pits, or non-forested openings.

In compliance with Forest Service Manual direction and manufacture's application instructions, some areas where herbicides would be applied might have to be temporarily closed to the public, to prevent people from contacting wet herbicide solutions on treated areas such as foliage, soil, or lake water (Table A-1). Boundaries around treated areas, near campgrounds or other areas heavily used by the public would be conspicuously posted with signs and/or tape alerting the public to the presence of herbicides. Remote areas subject to herbicide use would be posted with at least one sign in a conspicuous location. Herbicide applications generally would be scheduled to avoid public areas during times of heaviest demand, such as holidays, and weekends.

When herbicides are applied all label directions would be followed, which may include restriction of swimming, fishing, and other water contact activities. Bodies of water treated with aquatic herbicides might have to be temporarily closed to fishing and swimming following application. Signs alerting the public to aquatic herbicide use would be conspicuously posted at public entry points to treated waters such as boat ramps and road crossings. A list of restrictions provided on product labels for the different herbicides being considered is presented in Table A-2. Other applicable regulations may require additional restrictions, including temporary disabling of water wells near treatment areas.

Alternative 3

Evaluation of potential Direct and Indirect impacts of Alternative 2 also applies to Alternative 3, under which the same types of manual, mechanical or herbicide treatments or biological control agents could be used. These control activities could cause temporary impacts or disruption to existing vegetation. Because the total number of acres treated would be restricted to 1,000 acres annually, adverse impacts on land use, aesthetics, or recreation would be even briefer, more localized, and smaller than that expected for Alternative 2.

When possible, Forest Service personnel would seek to educate visitors regarding the use and purpose of biological control agents by notices in visitor centers or outdoor signage. All proposed biological agents have a history of successful and safe use in the Midwestern United States, and no proposed biological control agents have become a nuisance. Their use would not require any temporary land use restrictions.

Alternative 4

Alternative 4 includes the addition of utilizing vehicle-mounted spray or wick device applicators which could be employed on up to 40 acres per year and five optional herbicides (aminopyralid, fluridone, imazapic, imazapyr, and metsulfuron methyl) to implement the control of NNIP infestations on the HMNF. For example, infestation sites of spotted knapweed, effectively treated by chemical and/or biological control agents under Alternatives 2 or 3 might instead be treated using more efficient vehicle-mounted sprayer or wick device methods under Alternative 4. Those areas could display temporary visual or atheistic impacts because of increased exposed soil or uniformly-browned vegetation that would not occur if spot-chemical or biological controls were used instead. Impacts, however, likely would last no more than one growing season. The herbicides being added, in addition to those already mentioned under Alternative 2, include: aminopyralid, fluridone, imazapic, imazapyr, and metsulfuron methyl. By increasing the suite of selective herbicides from which to choose, we can more appropriately match a chemical to a target species to be controlled.

Cumulative Effects

Some past, present, and future recreational and land use activities contribute to the spread of non-native invasive plant (NNIP) species (see Table 4-1). Under Alternative 1, only limited NNIP control activities would occur on the Huron-Manistee National Forests, emphasizing sites along roadsides and in recreation areas. Consequently, large infestations of exotic honeysuckle, Japanese barberry, and glossy buckthorn would go mostly untreated. Nor would the Forest Service participate with the State or local Lake Associations in applying herbicides to control Eurasian water-milfoil infestations. Failure to control NNIP species on the Huron-Manistee National Forests, when combined with failure to control NNIP species (or intentional importation) on nearby or neighboring land could result in increasing regional dominance by NNIPs. This could contribute to long-term negative cumulative impacts to land use, recreation, and aesthetics.

Under Alternative 2, proposed control activities could result in some limited short-term adverse effects. Taking into account the limited extent of control activities proposed each year, any adverse incremental effects on land use, recreation, or aesthetics from proposed control activities would be temporary and relatively negligible. Because effects of these activities are essentially local in scope and minor in effect, they could contribute a small incremental adverse effect when combined with impacts of other past, present and reasonably foreseeable future activities outlined in Table 4-1. Native plant restoration activities are expected to cumulatively increase enjoyment of recreation visitors, productivity of land uses, and value of native aesthetics in the foreseeable future.

Total number of acres treated would be decreased under Alternative 3, so cumulative impacts are anticipated to be similar to, but even less, than those described for Alternative 2. Incremental positive and negative impacts on the cumulative baseline would be proportionately smaller.

Alternative 4 would be the same as Alternative 2 (with the addition of vehicle-mounted spray or wick device applied herbicide controls), so cumulative effects would be similar to those described under Alternative 2. However, because manual, mechanical and chemical control methods would be applied more efficiently, the cumulative impact on these resources could be equivalent to or less than that described for Alternative 2.

Treatment measures under Alternatives 2, 3, and 4 would therefore contribute little or no incremental effect upon land use, recreation, or aesthetics when combined with impacts of other past, present, and reasonably foreseeable future activities.

4.4 AIR QUALITY

The spatial scope of assessment of Direct and Indirect impacts on air quality is confined to the HMNF proclamation boundaries and adjacent lands to which reasonably foreseeable impacts of air emissions might pose a potentially significant impact. Temporal scope of this analysis on air quality spans the timeframe over which the proposal would run and a short additional period of time for air emissions to dissipate to a point that would not pose a potentially significant impact.

Assessment of cumulative impacts on air quality considers the scope of the Proposed Action, added to impacts of other past, present, and reasonably foreseeable future activities. Specifically, the spatial scope of cumulative impact analysis on air quality includes the HMNF proclamation boundaries and adjacent properties where proposed control activities could potentially combine with emissions from other similar Federal or non-Federal activities to produce a significant impact. The temporal timeframe extends over the course of the proposal and includes a short period following the end of this proposal in which impacts of air emissions could potentially contribute to a significant impact when combined with effects of other similar Federal or non-Federal activities (40 CFR 1508.7).

Alternative 1

NNIP plants do not generally affect air quality; hence the Alternative of taking No Action to control NNIP species would pose no potential Direct or Indirect impacts on air quality, unless their persistence increased the probability, intensity, or spread of wildfire, with concomitant smoke pollution.

Alternative 2

Beyond minimal amounts of dust, most manual or mechanical control would consist of manual cutting, pulling, or digging up invasive plants and would not produce any air emissions. Plowing, disking, or blading could occur in some already-disturbed sites such as gravel pits and would leave temporary areas of bare soil potentially susceptible to minor short-term wind-borne soil erosion. Any areas of soil left bare of vegetation following treatment would be seeded with a mix of fast-growing native or (in emergencies) persistent, non-native, non-invasive plant materials. Grasses, forbs, legumes, and/or shrubs planted for soil stabilization and erosion control would be those recommended by the HMNF botany program in compliance with Native Plant Materials Policy (FSM 2070), Eastern Region "Strategic Framework" on Native Plant Materials Policy.

Pursuant to State burning regulations and permitting requirements, some short-term minor smoke and ash emissions also may be generated from burning cut brush. Similarly, saws, line trimmers, mowers, motorized equipment, and vehicles would generate minor (de minimis) amounts of exhaust emissions. Trace amounts of ground level ozone could be produced by operation of vehicles or equipment with internal combustion engines. Considering the small extent of acreage to be treated annually under the proposed program, and natural wind-mixing regimes, any increased ground level ozone production would be negligible or not measurably greater than that associated with present vehicular activities in the region.

Methods of herbicide application can have substantially different effects on air quality. However, most herbicides proposed for use under this Alternative are not volatile (i.e., they are unlikely to vaporize and be carried by wind [drift] to unintended locations [Table A-3]). Exceptions are certain volatile ester formulations of 2,4-D and triclopyr. Growth-regulating herbicides such as 2,4-D and triclopyr can drift if applied inappropriately (Kansas State University 2001).

Potential for herbicide volatilization tends to rise with increasing temperature and soil moisture (Tu et al. 2001). Salt formulations of 2,4-D and triclopyr are less likely to vaporize than ester formulations, and use of salt formulations could be a desirable alternative to ester formulations in some instances (Tu et al. 2001; Putnam et al., undated). Forest Service staff would consider prevailing weather conditions and use lower-volatility formulations as necessary to prevent significant volatilization and drift.

Wind can cause herbicides to drift away from intended targets. Drift is generally considered to be below levels of substantial concern when wind speed is less than 10 miles per hour (See Project Design Criteria, Table 2-3).

Herbicide treatment methods using spot treatment and broadcast spraying may result in temporary, localized odors that may persist at the spray site for several hours or days. These herbicide formulations would be applied cautiously and only under appropriate atmospheric conditions. For example, herbicides would only be sprayed when wind is less than 10 miles per hour (following label direction and Project design criteria listed in Table 2-3), and volatile herbicide formulations would not be applied on hot days (greater than 85ºF). Therefore, these methods are not anticipated to result in substantial direct or indirect impacts to air quality.

Most proposed herbicide treatments would consist of manual application of herbicides to stumps and cut surfaces of woody vegetation (spot spraying), which would result in little or no drift, because applications are made close to the ground surface. Broadcast spraying (using booms from vehicles or tractors) could have greater impacts than spot spraying. Broadcast spraying, however, would be limited to disturbed areas, roadsides, and other non-forested areas.

Alternative 3

Analysis of potential direct or indirect effects for Alternative 2 also applies to Alternative 3, under which the same types of manual, mechanical and herbicide treatments, or biological control agents could be used. Because of the decreased extent of treatments (1,000 acres annually), the magnitude of impacts is projected to be somewhat smaller for Alternative 3 compared to Alternative 2. Any impacts resulting from activities proposed under Alternative 3 are anticipated to be minor, brief, and relatively localized.

Alternative 4

With the addition of vehicle-mounted sprayers potentially employed on up to 40 acres per year and five optional herbicides (aminopyralid, fluridone, imazapic, imazapyr, and metsulfuron methyl) to implement the control NNIP infestations on the HMNF, air quality effects of this Alternative are the same as Alternative 2. Although the acreage ceiling would be the same as under Alternative 2, it is possible that some areas infested by leafy spurge or spotted knapweed that might otherwise be treated using manually or mechanically-applied chemical agents under Alternatives 2 or 3 would instead be treated more efficiently with herbicides under Alternative 4. Thus, a potential exists for more concentrated dust generation from herbicide application, as well as slightly increased exhaust from internal-combustion engines, which could have a marginally increased impact on air quality. But, as with Alternative 2, effects on air quality from those manual, mechanical or herbicide treatments would still be relatively minor, brief, and localized.

Cumulative Effects

As noted in Chapter 3, air quality on the HMNF are generally considered to be good (Michigan Department of Environmental Quality 2003). Table 4-1 lists prominent past, present, and reasonably foreseeable future actions that can contribute to cumulative impacts on the HMNF. No known past, present, or reasonably foreseeable future actions are likely to appreciably degrade air quality over the foreseeable future.

Dust generated from limited use of manual, mechanical or chemical control measures, in conjunction with emissions from motorized equipment and vehicles, would not contribute substantially to degradation in air quality, when combined with similar effects from other present and reasonably foreseeable future actions, such as use by off-highway vehicles.

Herbicide drift can impair air quality, commercial forests, private homes, and limited agricultural lands in the surrounding area likely involved in limited application of herbicides. Due to limited National Forest areas proposed for treatment, use of herbicide safety procedures, and project design criteria, herbicide drift is considered to be small to negligible, and would therefore contribute little or no incremental increase when combined with other present and reasonably foreseeable herbicide applications. Consequently, there would be no substantial increase in cumulative herbicide air concentrations in the surrounding area under any of the Alternatives.

Treatment measures under Alternatives 2, 3, and 4 would therefore contribute little or no incremental effect upon air quality when combined with impacts of other past, present, and reasonably foreseeable future activities.

4.5 CULTURAL RESOURCES.

The spatial scope of assessment of Direct and Indirect impacts on Cultural Resources is confined to HMNF proclamation boundaries. Temporal scope of this analysis spans the timeframe over which the proposal would run (40 CFR 1508.8).

Cumulative impact assessment on Cultural Resources considers the scope of the Proposed Action when added to the impacts of other past, present, and reasonably foreseeable future activities. Specifically, the spatial scope of cumulative impact analysis includes the HMNF proclamation boundaries in which the proposed control activities could potentially combine with other similar Federal or non-Federal activities to produce a significant impact. Temporal scope of this cumulative impact analysis spans the timeframe over which other similar Federal or non-Federal activities were first conducted. Temporal timeframe extends to a reasonably foreseeable period following the end of this proposal in which impacts of Forest Service control activities could potentially contribute to a significant impact when combined with effects of other similar Federal or non-Federal activities (40 CFR 1508.7).

Invasive shrubs can cover up heritage sites, but this effect would be similar to that by other natural vegetation encroachment. The alternative of taking No Action to control the spread of most species of NNIP would have little or no potential for direct or indirect impacts to Cultural Resource sites on the HMNF. However, the ability of Forest workers to safely and accurately record and assess cultural properties which become infested with toxic varieties of NNIP could be negatively affected under Alternative 1.

Alternative 2

All proposed treatment methods for the control or eradication of NNIP on the Huron-Manistee National Forests are undertakings under the National Historic Preservation Act (NHPA) and require compliance with regulatory provisions of that act. Certain methods, namely those which do not appreciably disturb the soil or a property's above-ground structural or landscape components, can be determined to have no potential to cause effects to historic properties under the criteria set out at 36 CFR 800.16(i). These methods may include hand pulling of small, shallow-rooted vegetation, mowing, hand cutting, manual spraying or dabbing of chemical herbicides to individual plants, aquatic treatments, biological controls, and propane torch use. Review and documentation of NHPA compliance for undertakings involving these treatments can be minimal under 36 CFR 800.3(a)(1).

Treatments which have greater potential to affect historic properties include manual and mechanical methods such as digging, pulling of deeply rooted plants, disking, plowing and, possibly, the more intensive or extensive spraying or spreading of chemical herbicides. These treatments potentially either physically disturb the soil matrix or may otherwise affect integrity of the historic property. In some cases, which could involve any and all of the proposed treatments, an "effect" under NHPA may not be a direct physical or chemical alteration but one which may cause a change in the use of the property or in the traditional cultural or religious character of the property. For this reason, Treatment Protocols (Table 2-2) dictate that all annual treatments would be afforded timely review by the Forests' professional heritage resource staff, and any necessary protective measures would be implemented in consultation with Michigan State Historic Preservation Officer (MISHPO) and other interested parties. If Cultural Resources are encountered during NNIP treatments, such activities would be stopped pending further review by an archaeologist and the completion of any additional compliance responsibilities.

Alternative 3

Protection of Cultural Resource sites would be as described for Alternative 2. Potential impacts would be similar to those described for Alternative 2, although smaller areas could be affected (1,000 acres annually). Because of the decreased extent of treatments, magnitude of impacts is anticipated to be somewhat smaller for Alternative 3 compared to Alternative 2. Any impacts resulting from activities proposed under Alternative 3 are anticipated to be minor, brief, and relatively localized.

Alternative 4

Under Alternative 4, activities are the same as those described for Alternative 2, with the addition of vehicle-mounted sprayers on up to 40 acres per year and five optional herbicides to implement the control NNIP infestations on the HMNF. The herbicides being added, in addition to those already mentioned under Alternative 2, include: aminopyralid, fluridone, imazapic, imazapyr, and metsulfuron methyl. By increasing the suite of selective herbicides from which to choose, we can more appropriately match a chemical to a target species to be controlled. While acreage ceilings under Alternative 4 would be the same as Alternative 2, it is possible that some areas infested with leafy spurge or spotted knapweed that would be treated with manual, mechanical or chemical control under Alternatives 2 or 3 could be treated with vehicle-mounted chemical application methods under Alternative 4. Those areas could experience surface soil compaction, soil disturbance, or herbicide application that would be more than that experienced if only manual or mechanical control methods were used. However, this Alternative is not expected to result in effects to historical, cultural, or archaeological resources, provided timely heritage resource survey, compliance and protection protocols are followed as outlined above.

Cumulative Effects

Table 4-1 lists prominent past, present, and reasonably foreseeable future actions that can contribute to cumulative impacts on the HMNF. Because no proposed control activities would be implemented under the No-Action Alternative, this option would not appear to contribute to substantial adverse cumulative effects to Cultural Resource sites on the HMNF.

Current understanding of the effects of proposed control methods leads to the reasonable conclusion that they pose little risk to Cultural Resources, given completion of the measures specified in the treatment protocol.

Treatment measures under Alternatives 2, 3, and 4 would therefore contribute little or no incremental effect upon Cultural Resources when combined with impacts of other past, present, and reasonably foreseeable future activities.

4.6 HUMAN HEALTH AND SAFETY

The spatial scope of assessment of Direct and Indirect impacts, and Cumulative impacts on human health and safety in Section 4.6 is limited to the HMNF proclamation boundaries, and adjacent lands to which reasonably foreseeable impacts of proposed control actions might pose a potentially significant impact. Temporal scope of this analysis spans the timeframe over which the proposal would run, and any additional reasonably foreseeable period for these impacts to dissipate to a point that would not pose a potentially significant impact to human health (40 CFR 1508.7 and .8).

Alternative 1

The Alternative of taking No Action to control NNIP would not result directly in impacts to human health and safety. However, Eurasian water-milfoil can grow into large dense stands that may indirectly affect recreational uses (e.g., swimming, boating, and fishing) (Hoffman and Kearns 1997). Drowning incidents have been blamed on swimmers getting tangled in dense mats of Eurasian water-milfoil (Washington Department of Ecology 2004).

Certain NNIP, most notably wild parsnip and giant hogweed, can cause dermatitis on exposed human skin. Untreated infestations and continued spread of such species could reduce the ability of people to enter and enjoy portions of the HMNF safely.

Alternative 2

The most likely human impacts involve accidents with vehicles, tools, or equipment. However, manual or mechanical treatment measures pose only marginal safety risk to workers or the public, provided Job Hazard Analyses and safety practices routinely observed by the Forest Service or licensed contractors are employed. These safety practices and operator training focus on hazards related to operating mechanical equipment such as brushsaws in remote settings, as well as exposure of workers to natural hazards such as poison ivy, stinging or biting insects, snake bites and other similar hazards. Generally, the public would be excluded from treatment sites while work is in progress.

Chemical Treatment: The greatest safety concern involves workers applying herbicides. As noted earlier, herbicide label instructions, Forest Service Manual direction, and Pesticide Applicator licensing requirements would be followed. Areas treated with herbicides would be closed to the public for a period of time following application to prevent contact with recently treated foliage, soil, or water (Tables A-1 and A-2).

Tables showing toxicity data for the herbicides proposed for use under any alternative are found in appendix A.

Each risk assessment used extensive literature searches and unpublished studies submitted to Environmental Protection Agency (EPA) to support herbicide registration. Measures of risk were based on typical Forest Service uses of each herbicide. Proposed rates on the HMNF would be at the low end of their estimated range, since no silvicultural use is proposed. For all six herbicides, Risk Assessments showed no indications of risk to the general public. The upper ranges of plausible exposures of triclopyr, 2,4-D, and dicamba could pose some risk to pesticide applicators. Proposed HMNF use would be unlikely to reach these upper ranges of exposure, and protective equipment and safety precautions described below would further prevent risks to trained and licensed workers from chronic exposure.

Applicable Federal laws stipulate that a person or company must obtain a registration, or license, from EPA to distribute or sell a pesticide in the United States. Before registering a new pesticide or new use for a registered pesticide, EPA must first ensure that the pesticide (including any adjuvant, surfactants, or other ingredients and product contents), when used according to label directions, can be applied with a reasonable certainty that it would not harm human health, and would not pose unreasonable risks to the environment. To make such determinations, EPA requires more than 100 different scientific studies and tests from applicants (U.S. Environmental Protection Agency 2008). The State also reviews pesticide labels to ensure that they comply with federal labeling requirements and additional state restrictions of use.

All workers applying pesticides on the HMNF, whether Forest Service or contractor personnel, would either be licensed applicators or supervised by licensed pesticide applicators. Label direction for Personal Protection Equipment (PPE) would be enforced at all times. Water for eyewash use would be available in the field in the unlikely event that a worker's eyes are exposed to herbicide. Simple precautions such as not eating or drinking while working with herbicides would provide protection against oral exposure (risk indicated by the oral LD50 data in Table A-8).

Some herbicide treatments, such as applying aquatic herbicide for Eurasian water-milfoil control, may require respirators. However, as noted earlier, inhalation exposure is not likely to be significant because of low volatility of most proposed herbicides.

Dermal exposure (e.g., skin contact and absorption) protection would be provided by requiring applicators to wear appropriate gloves, eye protection, boots, long-sleeved shirts and trousers while working with herbicides, and washing hands and clothing following work. Risk indicated by the dermal LD50, skin irritation, and skin sensitization data are summarized in Table A-8.

<u>Biological Agent Treatment:</u> Proposed biological agent treatments involve insects that have been approved for release in the United States by the United States Department of Agriculture (USDA), Animal and Plant Health Inspection Services (APHIS). These insects all have been introduced previously into Michigan or other Midwestern states. No published literature or information available for review suggests that these insects could be directly harmful to humans (e.g., serving as vectors for human diseases). It is theoretically possible that biological control agents could prove harmful to non-targeted plants and wildlife. However, specific agents proposed for use on the HMNF have a substantial body of research and history of use in the

United States that suggests that risk is negligible. Releasing these insects does not require use of any chemicals or equipment (other than vehicles) and hence involves none of the safety risks associated with manual, mechanical or chemical controls.

Alternative 3

Evaluation of potential direct and indirect impacts for Alternative 2 also applies to Alternative 3, under which similar manual, mechanical or herbicide treatments or biological control agents would be used, in lesser amounts. Impacts generally would be similar to those described for Alternative 2, as long as the same safety precautions are taken. However, because of decreased extent of treatments (1,000 acres annually), any potential impacts resulting from Alternative 3 would be somewhat less than those described for Alternative 2. Any risk is expected to be even more short-term and localized.

Alternative 4

Alternative 4 is the same as Alternative 2, with the addition of vehicle-mounted herbicide spray or wick device employed on limited acres. Five optional herbicides to implement the control NNIP infestations on the HMNF were also added. The herbicides being added, in addition to those already mentioned under Alternative 2, include: aminopyralid, fluridone, imazapic, imazapyr, and metsulfuron methyl. By increasing the suite of selective herbicides from which to choose, we can more appropriately match a chemical to a target species to be controlled. As the same types of manual, mechanical and herbicide treatments would be used, potential Direct or Indirect Effects on human health and safety are expected to be approximately similar to or bounded by analysis of effects presented for Alternative 2. It is possible that a few areas that might otherwise be treated by manual, mechanical and herbicide treatments under Alternatives 2 or 3 would instead be treated with more efficient vehicle-mounted herbicide spray under Alternative 4. Use of small ORVs or tractors could modestly raise the risk of accidents. However, staff training and adherence to safety measures would reduce the risk of potential accidents. No safety hazards associated with the use of vehicle-mounted herbicide sprays proposed for use as part of Alternative 4 are known or suspected.

As described for Alternative 2, safety precautions taken by workers and herbicide applicators would ensure the safety of workers, applicators and the public.

Cumulative Effects

The No-Action Alternative would not contribute directly to any adverse cumulative impact to human health. However, failure to control the spread of Eurasian water-milfoil might indirectly contribute to a cumulatively increased risk of drowning incidents among swimmers, and untreated skin-irritant NNIP might contribute to a cumulative increase in human dermatitis among Forest visitors.

Manual, mechanical, chemical and biological control methods described in Alternative 2 would pose only a minimal cumulative risk to human health or safety, among either workers or the public. They pose little or no incremental risk when combined with impacts of other past, present or reasonably foreseeable future activities outlined in Table 4-1. Consequently, these control methods are not expected to contribute to any substantial cumulative increase in risk to human health or safety among either workers or the public.

Landowners, private home owners, agricultural operators and other members of the public within and adjacent to the boundaries of the HMNF use various types of herbicides. Consequently, under all Alternatives, small amounts of herbicides might migrate onto the Forests, contributing to a negligible increase in cumulative concentrations or effects. However, due to herbicide breakdown and other factors, any incremental cumulative increase in concentrations or effects would be short-term and relatively localized.

Over the reasonably foreseeable future, increasing numbers of the public are likely to recreate at HMNF picnic areas, campgrounds, trails, and other areas. To mitigate risk of public exposure to herbicides, label direction, Forest Manual direction, and design criteria specify that application sites be posted with restricted entry signs. The large size of the HMNF and infrequent nature of herbicide treatments further limit likelihoods that the public would be exposed to any cumulatively harmful herbicide concentrations or effects.

Individuals subject to the highest cumulative risk of herbicide exposure are Forest Service staff and contractors hired to apply herbicides. Such individuals may be cumulatively exposed to repeated herbicide doses. For example, herbicide applicators moving from site-to-site, repeatedly applying herbicides, would be at greater risk for receiving cumulative herbicide exposures, unless protective measures are followed.

Recent studies have shown increased risks to human reproductive health from exposure to 2,4-D. Cavieres et al. (2002) showed developmental toxicity in mice from a mixture of 2,4-D, mecoprop, and dicamba at concentrations lower than the maximum contaminant level established by the EPA. Garry et al. (1996) and Schreinemachers (2003) showed significantly higher frequencies of birth defects among pesticide applicators in wheat crop areas of Minnesota, Montana, North Dakota, and South Dakota. Both studies suggested effects were due to exposure to chlorophenoxy herbicides, particularly 2,4-D. Proposed safety precautions required of herbicide applicators should reduce risks of exposure to any herbicides, including 2,4-D. However, if information becomes available over the course of the proposed NNIP control program that any proposed herbicide is not as safe as anticipated, the Forest Service would re-evaluate its use and consider eliminating that herbicide(s) from the remainder of the program, or impose stricter design and application criteria for its handling and use.

As indicated by studies cited above, there may be some increased cumulative risk to workers who apply or work in the vicinity of herbicides on a regular basis, or who are exposed to herbicides repeatedly. All herbicide applications would be performed by licensed pesticide applicators, whether Forest Service or contractor staff. All licensed pesticide applicators are trained in safety precautions that protect their health when working with pesticides on a regular basis.

As the total number of acres treated would be decreased under Alternative 3, cumulative impacts on human health and safety are also anticipated to be smaller than or bounded by those under Alternative 2.

Because Alternative 4 would be the same as Alternative 2 (with the addition of vehicle-mounted herbicide spray employed to limited acres), cumulative effects would be similar to those described under Alternative 2. Herbicides might be applied at slightly higher rates or concentrations over very limited acreage by vehicle-mounted sprayers, but no appreciable incremental herbicide concentration is expected that would contribute to additional concentrations or human exposures from other past, present, and reasonably foreseeable future control actions.

With the possible exception of decreasing the potential for watercraft accidents or contacting dermatitis, treatment measures under Alternatives 2, 3, and 4 would contribute little or no incremental effect upon human health and safety when combined with impacts of other past, present, and reasonably foreseeable future activities.

4.7 Socioeconomic Impacts

This section evaluates the direct and indirect impacts on socioeconomic resources, including Environmental Justice (EJ).

Direction in 40 CFR 1508.8 focuses the spatial scope of assessment of Direct and Indirect Effects on Socioeconomic resources to HMNF proclamation boundaries and adjacent lands to which reasonably foreseeable impacts of the Proposed control Action might pose a potentially significant impact. Temporal scope of this analysis of effects upon Socioeconomic resources spans the timeframe over which the proposal would run and any additional reasonably foreseeable period which would continue after the proposal has been completed (40 CFR 1508.8). This analysis includes Environmental Justice and growth-induced effects.

Cumulative impact assessment on Socioeconomic resources considers the scope of the Proposed Action when added to the impacts of other past, present, and reasonably foreseeable future activities. Specifically, the spatial scope of cumulative impact analysis on Socioeconomic resources includes HMNF proclamation boundaries and adjacent properties where proposed control activities could potentially combine with other similar Federal or non-Federal activities to produce a significant impact. Temporal scope of this cumulative impact analysis spans the timeframe over which other similar Federal and/or non-Federal activities have been conducted. The temporal timeframe extends to a reasonably foreseeable period following the end of this proposal in which impacts of Forest Service control activities could potentially contribute to a significant impact when combined with the effects of other similar Federal or non-Federal activities (40 CFR 1508.7); this analysis also includes Environmental Justice and growth induced effects.

Alternative 1

There would be a small, immediate direct effect on social conditions, local, or regional employment, and revenue generated as a result of taking No Action. This effect stems from delay or deferral of management activities that require proactive NNIP treatments prior to undertaking these activities. However, failure to take appropriate action at this time would result in an accelerated invasion of NNIPs, which would result in the need for more expensive control measures in the future. At some point, invasive species' populations could reach a level at which it would no longer be as feasible to eliminate it from the Project Area. Wildlife habitat across the

HMNF and upland and wetland ecosystems are being impacted negatively by several NNIP species, and are threatened by numerous other non-native species that are likely to become invasive in the near future. Over time, habitat for native plants would be lost and degraded, wildlife habitat would be degraded, and ETS plant and animal species would be impacted. The consequence of unchecked NNIP spread is decreased quality wildlife habitat and eventual diminished wildlife hunting opportunities, which could result in an eventual decrease in tourism.

Control of certain NNIP species that are nectar plants, such as spotted knapweed, could affect local honey bee industry. Under this Alternative, local honey bee industry would not be affected immediately, because NNIP species that are nectar plants would not be treated. However, other native invertebrates and pollinators likely would be affected because current distribution of NNIP infestations on the HMNF threatens the biodiversity of native ecosystems and negatively alters native species composition, reducing pollination opportunities for agricultural (fruit) crops by native pollinators. NNIP species can out compete some native vegetation in agricultural and Forestry settings. By not attempting control at this time the rate of spread of existing populations will increase.   And in time, monocultures of NNIP may prove less supportive of honey bees and honey production.

Alternative 2

This Alternative would result in a slight positive effect on local or regional social conditions such as employment associated with NNIP treatments because of the limited size of the proposed control activities.

Some apiarists are concerned that control of certain nectar plants that are also NNIP species, such as spotted knapweed, could affect the local honey bee industry. For honeybees, clopyralid, dicamba, endothall, FAS, glyphosate, sethoxydim, and triclopyr are nontoxic (Table A-6; http://www.fs.fed.us/foresthealth/pesticide/risk.shtml).

While 2,4-D is not likely to cause mortality among honey bees at any of the application rates employed by the Forest Service (USDA Forest Service 2006a), moderate doses of 2,4-D severely impaired honeybee's brood production. The honeybee LD50 is 0.0115 mg/bee for 2,4-D (Extoxnet, 1996). Mortality would be highly improbable using ground based equipment and accepted operating procedures. Herbicide drift would be negligible with application of the herbicide when wind speeds are less than 10 mph (Table 2-3 Project Design Criteria), or according to label direction, to minimize herbicide drift.

Since such a small amount of acreage (0.02%/year) and only priority habitats or priority sources of NNIP spread would be treated, NNIP species would certainly continue their presence and would likely increase across the HMNF, even with treatment under this Alternative. Therefore, NNIP nectar plants and the local honey bee industry would not likely be appreciably affected by this small scale NNIP control project.

Opportunities for local contract work to assist the Forest Service in performing NNIP treatments might be created, although this would present only a minor increase in employment. Direct expenses of the Forest Service would increase to accomplish NNIP control and eradication treatments. People visiting the HMNF might be displaced temporarily as a result of temporarily limiting access to some small areas as treatments are implemented.

Table 4-2 below lists proposed NNIP treatment methods and estimated costs per acre. These costs are the same for Alternatives 2, 3, and 4 with the exception that Alternative 2 could treat up to 2,000 per year with a combination of these methods, Alternative 3 could treat up to 1,000 acres per year, and Alternative 4 includes mechanical herbicide application. Under Alternative 1, no NNIP would be treated under this proposal. The hand pulling manual technique may be effective for controlling small infestations but this method would not be effective for larger infestation areas. However, removal would likely need to be repeated for a number of NNIP species. Mechanical removal of some species, such as autumn olive and honeysuckle, would need to be conducted twice a year for 3-5 years and is not as effective as herbicide use. This method is also more labor intensive and would take a much longer period of time to be effective.

Table 4-2: Estimated Costs of Non-native Invasive Plant Treatments

NNIP Treatment Method	Cost/Acre
Manual Treatment	$600/$2000
Mechanical Treatment	$50
Propane Weed Torch Spot Treatment	$350-$800
Herbicide Spot Treatment	$350-$800
Mechanical Broadcast Herbicide Application	$50
Aquatic Herbicide Application	$800
Biological Control Release	$50

Alternative 3

Since the total number of acres treated would be decreased under this alternative, any Direct and Indirect impacts on Socioeconomic resources are expected to be less than or bounded by those described for Alternative 2. Potential Socioeconomic effects are expected to be similar and proportionately smaller than Alternative 2.

Alternative 4

Socioeconomic Impacts of Alternative 4 would be the same as Alternative 2, with the addition of mechanized herbicide application and five optional herbicides (aminopyralid, fluridone, imazapic, imazapyr, and metsulfuron methyl) to implement the control NNIP infestations on the HMNF.

Some apiarists are concerned that control of certain nectar plants that are also NNIP species, such as spotted knapweed, could affect the local honey bee industry. The HMNF only proposes treating up to 2,000 acres per year. This is .002 percent per year of the 980,000 Forest. For honeybees, aminopyralid, clopyralid, dicamba, endothall, FAS, fluridone, glyphosate, imazapic, imazapyr, metsulfuron, picloram, sethoxydim, and triclopyr are nontoxic (Table A-6; http://www.fs.fed.us/foresthealth/pesticide/risk.shtml).

While 2,4-D is not likely to cause mortality among honey bees at any of the application rates employed by the Forest Service (USDA Forest Service 2006a), moderate doses of 2,4-D severely impaired honeybee's brood production. The honeybee LD50 is 0.0115 mg/bee for 2,4-D (Extoxnet, 1996). Mortality would be highly improbable using ground based equipment and accepted operating procedures. Herbicide drift would be negligible with application of the herbicide when wind speeds are less than 10 mph (Table 2-3 Project Design Criteria), or according to label direction, to minimize herbicide drift.

Since such a small amount of acreage (0.02%/year) and only priority habitats or priority sources of NNIP spread would be treated, NNIP species would certainly continue their presence and would likely increase across the HMNF, even with treatment under this Alternative. Therefore, NNIP nectar plants and the local honey bee industry would not likely be appreciably affected by this small scale NNIP control project.

Opportunities for local contract work to assist the Forest Service in performing NNIP treatments might be created, although this would present only a minor increase in employment. Direct expenses of the Forest Service would increase to accomplish NNIP control and eradication treatments. People visiting the HMNF might be displaced temporarily as a result of temporarily limiting access to some small areas as treatments are implemented.

Cumulative Effects

Under Alternative 1, no steps would be taken that would directly result in any substantial increase or change in social conditions, or local or regional employment. Adverse Socioeconomic impacts would be slight initially, but would increase over time, so direct incremental effects could occur when combined with the Socioeconomic impacts of other past, present and reasonably foreseeable future activities outlined in Table 4-1.

Under Alternative 2, as a result of the limited size of proposed manual, mechanical, chemical, and biological control activities, Socioeconomic impacts of employment, revenue, or social conditions of at-risk populations could increase slightly. Because these Socioeconomic effects would be moderately positive, they would increase the incremental effect when combined with impacts of other past, present and reasonably foreseeable future activities outlined in Table 4-1.

Consequently, a positive effect from sustaining biological and economic resource bases might be observed or experienced.

Because the total number of acres treated under Alternative 3 would be less than in Alternative 2, cumulative impacts on Socioeconomics would be similar to or less than those described for Alternative 2.

Since Alternative 4 would be the same as Alternative 2, with the addition of mechanized herbicide use, cumulative effects would be similar to those described under Alternative 2, or perhaps marginally better.

4.7.1 Environmental Justice Impacts

Under Executive Order 12898, titled Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations, Federal agencies are directed to take appropriate steps to identify, address, and mitigate disproportionately high and adverse impacts of Federally-funded projects on the health and socioeconomic condition of minority and low-income populations. Ethnic minorities are defined as African Americans, American Indian and Alaska Native, Asian, Hispanic or Latino, and Native Hawaiian and other Pacific Islanders. Low income persons are defined as people with incomes below the Federal poverty level.

According to 2000 US Census figures, Michigan's population is approximately 20 percent minority and 10.5 percent low-income. The proportion of minority and low-income populations for counties within HMNF proclamation boundaries and adjacent lands is less than twice that of the State of Michigan (which would be 40 percent minority and 21 percent low-income) (see Tables 4-3 and 4-4 below).

Table 4-3. Proportion of Minority Populations in Michigan and Counties within the Project Analysis Area

Location	**Percent Minority Populations**
Michigan	19.8
Alcona County	2.0
Alpena County	6.5
Crawford County	3.6
Iosco County	3.1
Lake County	15.3
Manistee County	5.8
Mason County	4.2
Missaukee County	2.5
Montmorency County	1.6
Muskegon County	18.7

Table 4-4. Proportion of Population Below Poverty in Michigan and Counties within the Project Analysis Area

Location	**Percent of Population Below Poverty Level**
Michigan	10.5
Alcona County	12.6
Alpena County	10.5
Crawford County	12.7
Iosco County	12.7
Lake County	19.4
Manistee County	10.3
Mason County	11.0
Missaukee County	10.7
Montmorency County	12.8
Muskegon County	11.4

Newaygo County	5.2		Newaygo County	11.6
Oceana County	9.6		Oceana County	14.7
Ogemaw County	2.5		Ogemaw County	14.0
Osceola County	2.5		Osceola County	12.7
Oscoda County	2.2		Oscoda County	14.6
Otsego County	2.5		Otsego County	6.8
Roscommon County	2.0		Roscommon County	12.4
Wexford County	2.7		Wexford County	10.3

Source: 2000 US Census Source: 2000 US Census

Effects Common to All Alternatives

No Alternative is expected to affect the civil rights of any landowners, or other individuals within HMNF proclamation boundaries and adjacent lands. No discrimination based on race, color, national origin, gender, religion, age, disability, political beliefs, sexual orientation, and marital or family status would occur due to any Alternative. Laws, rules, and regulations governing nondiscrimination conduct in government employment would be employed. No alternative is expected to impact human populations disproportionately. No human health or safety factors are associated with any Alternative that would affect low-income or minority populations within HMNF proclamation boundaries and adjacent lands. Because civil rights, low income, and minority populations are not expected to be impacted by this project, there are also no expected cumulative effects.

Adverse impacts resulting from these activities could vary among communities and minority populations within the National Forests. Project design criteria outlined in Table 2-3, including short-term closures during herbicide applications, should ensure that proposed activities would have no impact (disproportionate, adverse or otherwise) on the health or wellbeing of minorities or low income populations.

4.8 COST-BENEFIT ASSESSMENT

Table 4-5 summarizes the costs versus the benefits of pursuing this proposal.

Table 4-5
Cost-Benefit Analysis of the Proposal

Costs	Benefits
Small numbers of individual plants and animals may be killed or injured by trampling, vehicles, and manual or mechanical activities such as mowing. The number of affected individuals is limited by the small spatial extent of treatment (2,000 acres per year for Alternatives 2 and 4, and 1,000 acres for Alternative 3). Conservation Measures outlined in the BE would further limit the number of Sensitive species individuals affected. Results in short-term, modest impacts upon resources such as land use, viewscape, or erosion. Could eliminate some NNIP species such as spotted knapweed and yellow sweet clover that are nectar sources for honey bees. However, could simultaneously provide additional habitat for native nectar sources such as milkweeds and goldenrods. To offset any possible net decline in nectar sources, the Forest Service could plant some areas previously infested with NNIP nectar sources with native plant nectar sources.	Sustains productivity and biodiversity of a variety of ecosystems Protects susceptible ETS plants from more aggressive NNIP species Protects quality of habitats for several ETS species, including Karner blue butterfly, Kirtland's warbler, and Michigan bog grasshopper Promotes retention of natural viewscapes Control of Eurasian Water-Milfoil would decrease human risk of drowning. Allelopathic chemicals (molecules produced by plants that harm other plants) released by certain exotic plants such as exotic buckthorns and barberries into the soil could inhibit establishment of native plants. Therefore, taking No Action to control NNIP infestations could eventually result in adverse impacts to these resources. Provides human community stability and maintains diversity of existing economic bases.

4.9 COMPARISON OF IMPACTS

Table 4-6 provides an Impact Assessment Matrix which summarizes and compares principal environmental resource impacts for each Alternative described in Sections 4.1 through 4.7 of this chapter.

Table 4-6. Comparison of Alternatives By Principal Resource Impacts.

Resource Category	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Vegetation	Taking No Action to effectively control NNIPs would likely result in continued infestations, decreasing diversity and abundance of regionally indigenous plant species.	Manual, mechanical and chemical control measures could result in relatively small short-term adverse effects to non-target plants; however, long-term effective control of NNIPs could enhance survival of native vegetation. Biological controls would pose no threat to non-target species.	Effects on vegetation would be similar to those described for Alternative 2; however, because of reduced acreage, these effects are expected to be less than or bounded by those of Alternative 2.	Impacts associated with manual, mechanical and chemical control methods and five optional herbicides to implement the control NNIP infestations on the HMNF generally would be as described for Alternative 2. Impacts from increasing the suite of selective herbicides should not be marginally larger as it allows the Forests to more appropriately match a chemical to the controlled target species. Because vehicle-mounted chemical application methods may be more locally concentrated, impacts associated with chemical controls might be marginally larger.

Resource Category	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Wildlife	Taking No Action to effectively control NNIPs would result in no direct adverse effects to wildlife or fish. However, failure to control NNIP infestations would allow continued infestation of wildlife habitat areas, which is expected to reduce their value and function. It might also affect the food supply of some wildlife.	Herbicide use could pose some small, short-term adverse risk to wildlife and their habitats, especially less-mobile life stages such as eggs, young, or insect larvae and pupae. However, effective NNIP control would also enhance the native food supply of some wildlife. Only herbicide formulations labeled for use in aquatic areas would be sprayed in, on or around waters, wetlands, or riparian areas.	Impacts on wildlife would be similar to those described for Alternative 2; however, because of reduced acreage, these effects are expected to be less than or bounded by those of Alternative 2.	Wildlife impacts associated with Alternative 4 generally would be similar to those described for Alternative 2. However, because vehicle-mounted chemical application methods may be more locally concentrated, impacts associated with chemical controls might be marginally larger. Impacts from increasing the suite of selective herbicides should not be marginally larger as the toxicity of the additional herbicides fall within the range of the herbicides originally proposed in alternative 2. Data suggest that the herbicides proposed for use in terrestrial and wetland settings are generally safe to mammals, birds, and other wildlife, if used in accordance with the manufacturer's label. Practices that follow precautions, Standards and Guidelines should pose no risk to ETS species.

Resource Category	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Endangered, Threatened and Sensitive Species	Taking No Action to control NNIPs could result in continued or increasing competition between NNIP and ETS plants, and decreasing habitat for ETS fish and wildlife.	Manual or mechanical control methods could result in relatively small short-term adverse effects to non-target wildlife. Herbicides could pose some small, short-term adverse effects to Endangered, Threatened, or Sensitive species. Only herbicide formulations labeled for use in aquatic areas would be sprayed in, on or around waters, wetlands, or riparian areas. However, that could also help protect Sensitive native species.	Impacts would be similar to those described for Alternative 2; however, because of reduced acreage, these effects are expected to be less than or bounded by those of Alternative 2.	Impacts associated with Alternative 4 generally would be similar to those described for Alternative 2. However, because vehicle-mounted chemical application methods may be more locally concentrated, impacts associated with chemical controls might be marginally larger. Impacts from increasing the suite of selective herbicides would generally be similar to those from Alternative 2. The BE assigns the same determinations for each Sensitive species under Alternative 4 that it does under Alternative 2. Practices that follow precautions, Standards and Guidelines should pose no risk to ETS species.

Resource Category	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Soils, Geology, and Hydrology	Taking No Action to control NNIPs would not directly affect soils, geological, or hydrology resources. However, taking No Action to control NNIP infestations could indirectly affect soils and changes in hydrological flow patterns.	Manual or mechanical treatment methods could result in temporary exposure of bare soil, but proposed soil erosion and sediment control measures would substantially address any erosion problems. Herbicides could briefly leave residues in soils and water, but proposed herbicides have a relatively short half-life in the Forests environments.	Effects would be similar to those described for Alternative 2; however, because of reduced acreage, effects are expected to be less than or bounded by those of Alternative 2.	Impacts associated with Alternative 4 would be similar to those described for Alternative 2. However, because vehicle-mounted chemical application methods may be more locally concentrated, impacts associated with chemical controls might be marginally larger. Impacts from increasing the suite of selective herbicides should not be marginally larger. If the optional herbicides are used (aminopyralid, fluridone, imazapic, imazapyr, and metsulfuron methyl) in accordance with label specifications, and design criteria outlined in Table 2-3, no long-term impacts to soils or geological resources are anticipated.

Resource Category	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Water Quality	Taking No Action to treat NNIPs would have no substantial direct adverse effects on water quality.	Small short-term sedimentation and accumulation of herbicides in surface and groundwater bodies could occur. However, proposed herbicides have a relatively short half-life in the Forests environments.	Water quality impacts would be similar to those described for Alternative 2; however, because of reduced acreage, these effects are expected to be less than or bounded by those of Alternative 2.	Water quality effects would be similar to those described for Alternative 2. However, because vehicle-mounted chemical application methods may be more locally concentrated, impacts associated with chemical controls might be marginally larger. Impacts from increasing the suite of selective herbicides should not be marginally larger as it allows the Forests to more appropriately match a chemical to the controlled target species.

Resource Category	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Land Use, Recreation, and Aesthetics	Taking No Action to treat NNIPs would not directly affect land use, recreation, or forest aesthetics. However, continued spread of NNIP infestations could indirectly interfere with recreation and reduce the aesthetic quality of the landscape.	Few adverse effects on land use, recreation, or forest aesthetics would occur. Some treatment could result in temporary aesthetic changes but those changes would disappear as native vegetation replaces NNIP species that have been killed. Some herbicide-treated areas may be temporarily closed to public access.	Impacts would be similar to those described for Alternative 2. However, because of reduced acreage, these effects are expected to be less than or bounded by those of Alternative 2.	Impacts would be similar to those described for Alternative 2. However, because vehicle-mounted chemical application methods may be more locally concentrated, impacts associated with chemical controls might be marginally larger. Impacts from increasing the suite of selective herbicides should not be marginally larger as it allows the Forests to more appropriately match a chemical to the controlled target species.

Resource Category	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Air Quality	Taking No Action to treat NNIPs would have no adverse effects on air quality.	Some manual or mechanical control methods could result in temporary exposure of bare soil, but proposed soil erosion and sediment control measures would address possible fugitive dust generation. Some herbicides might volatilize for short periods following application but proposed herbicides are generally of low volatility and would affect only small local areas for short periods. Relatively small air emissions could be produced from burning cut brush, or from use of weed torches and vehicles or equipment.	Air quality effects would be similar to those described for Alternative 2; however, because of reduced acreage, these effects are expected to be less than or bounded by those of Alternative 2.	Air quality impacts would be similar to those described for Alternative 2. However, because vehicle-mounted chemical application methods may be more locally concentrated, impacts associated with chemical controls and exhaust emissions might be marginally larger. Effects on air quality from those manual, mechanical or herbicide treatments would still be relatively minor, brief, and localized.

Resource Category	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Human health and safety	Outside of an increased risk of drownings, taking No Action would have no affect on Human Health or Safety.	Risk of vehicular and equipment accidents associated with manual or mechanical treatment activities may increase slightly. Principal risk is of toxic effects related to herbicide use, particularly for workers. Proper adherence to safety procedures and protocols should substantially reduce most of this risk. Biological agents are not expected to present any risk to humans.	Safety and human health impacts would be similar to those described for Alternative 2; however, because of reduced acreage, these effects are expected to be less than or bounded by those of Alternative 2.	Because use of biological control agents has little potential to affect Human Health or Safety, effects generally would be as described for Alternative 2. However, because vehicle-mounted chemical application activities may be more locally concentrated, impacts associated with chemical controls and exhaust emissions might be marginally larger. Impacts from the use of the five optional herbicides should not be marginally larger as it allows the Forests to more appropriately match a chemical to the controlled target species.

Resource Category	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Cultural Resources	Taking No Action to control NNIP infestations would have no direct adverse effects on Cultural Resources.	Some control methods could affect archaeological resources. Proposed treatments would first be reviewed by a qualified archaeologist and appropriate measures would be taken to preserve historical records.	Effects on Cultural Resources would be similar to those described for Alternative 2; however, because of reduced acreage, these effects are expected to be less than or bounded by those of Alternative 2.	Because use of biological control agents has little potential to affect Cultural Resources, effects would be generally as described for Alternative 2. However, because vehicle-mounted chemical application activities may be more locally concentrated, impacts associated with chemical controls might be marginally larger. This Alternative is not expected to result in effects to historical, cultural, or archaeological resources, provided timely heritage resource survey, compliance and protection protocols are followed. Impacts from the use of the five optional herbicides should not be marginally larger as it allows the Forests to more appropriately match a chemical to the controlled target species.

Resource Category	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Socioeconomics	Taking No Action and failing to effectively control spread of NNIP species would result in long-term indirect detrimental economic impacts by reducing local recreational activities and revenue derived from forest commodity production. Additionally, failure to take appropriate action at this time would result in accelerated invasion of NNIPs, which would result in the need for more expensive control measures in the future. Honeybees could nectar on NNIP, but native pollinators might be lost to NNIP competition with native nectar sources	There would be little or no impact upon local or regional Socioeconomics. However, it could affect local honey bee industry slightly, by reducing NNIP nectar sources on 0.02% of the Forests in a year. This potential economic impact could be reduced by planting substitute plants that can be used by honey bees as a source for nectar.	Socioeconomic impacts would be similar to those described for Alternative 2. However, because of reduced acreage, these effects are expected to be less than or bounded by those of Alternative 2.	Socioeconomic impacts would be similar to those described for Alternative 2. However, including the option of mechanized herbicide application and five additional herbicides would potentially generate greater employment opportunities for this herbicide application method. Additional mechanized herbicide application treatment may slightly decrease costs of NNIP control, compared to Alternative 2 Concern that control of certain nectar plants that are also NNIP species, such as spotted knapweed, could affect the local honey bee industry. For honeybees, aminopyralid, clopyralid, dicamba, endothall, FAS, fluridone, glyphosate, imazapic, imazapyr, metsulfuron, picloram, sethoxydim, and triclopyr are nontoxic.

Resource Category	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Environmental Justice	Taking No Action would have little or no adverse effect on property owners bordering Forest Service lands. Minority and low-income populations would not be disproportionately impacted by this project.	No Alternative is expected to disproportionately impact human populations. No human health or safety factors associated with the Alternatives would affect low-income or minority populations within the HMNF proclamation boundaries and adjacent lands.	Environmental Justice impacts would be similar to those described for Alternative 2.	Environmental Justice impacts would be similar to those described for Alternative 2. Addition of mechanized herbicide application and five additional herbicides might pose very slight benefits to local employment, benefiting low-income populations.

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Chapter 6 CITATIONS

36 CFR 800.16(i) – Protection of Historic Properties, Definitions.

36 CFR 800.3 – Protection of Historic Properties, Definitions, Initiation of the section 106 process.

40 CFR 170.122 – Worker Protection Standard, Entry Restrictions.

40 CFR 1502.14d – Environmental Impact Statement, Alternatives Including the Proposed Action.

40 CFR 1508.7 - Terminology and Index, Cumulative Impact.

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APPENDIX - REFERENCE TABLES

Table A-1. General Guidelines for Reentry into Areas Treated with Herbicides

Herbicide	Non-Worker Protection Standard Uses	Restricted Entry Interval (REI) (under Worker Protection Standard, 40 CFR 170.112)
2,4-D acetic acid	Do not allow people or pets on treatment area during application, or until sprayed areas have dried.	48 hours
Aminopyralid	Not stated on label.	12 hours
Clopyralid	Not stated on label	12 hours
Endothall	Labels for endothall formulations designed for aquatic weed control (e.g., Aquathol K) restrict consumption of fish from treated waters for three days.	
Dicamba	Not Stated on label (Banvel)	24 hours
Fluridone	Not stated on label.	Not stated on label.
Fosamine ammonium salt	Not stated on label	Not stated on label
Glyphosate	Keep people and pets off treated areas until spray solution has dried.	12 hours
Imazapic	Not stated on label.	12 hours
Imazapyr	Not stated on label.	Not stated on label.
Metsulfuron Methyl	Do not enter or allow others to enter the treated area until sprays have dried.	4 hours
Sethoxydim	Not stated on label	12 hours
Triclopyr	Not stated on label	48 hours

Note: Table is adapted from Environmental Assessment of Herbicide Use for Invasive Plant Species and Noxious Weeds Control on the Midewin National Tallgrass Prairie, Will County, Illinois, April 2002. Data obtained from herbicide product labels.

Table A-2. Michigan DEQ and label requirements for aquatic use of 2,4-D, Endothall, Fluridone, Imazapyr, and Triclopyr

Brand names (sample)	Active ingredient	Form	Selectivity	Swimming restrictions	Fishing restrictions	Other restrictions
Aqua-Kleen, Navigate, Aquacide	2,4-D	Granular systemic herbicide	Broadleaf (dicot) plants are susceptible. Navigate and Aqua-Kleen labels suggest that milfoil is particularly susceptible.	No swimming for 1 day	No restrictions	Do not apply within 75 feet of any drinking water well or within 250 feet of drinking water wells that are less than 30 feet deep. Do not use water from treated areas for irrigating plants or mixing sprays for agricultural or ornamental plants, unless an approved assay indicates the 2,4-D concentration is 100 ppb (or less), or only growing crops and non-crop areas labeled for direct treatments with 2,4-D will be affected. Do not use water from treated areas for potable water, unless an approved assay indicates the 2,4-D concentration is 70 ppb (or less).
Aquathol K, Hydrothol 191	Endothall	Liquid or granular contact herbicide	All submerged plants (monocot and dicot) are susceptible.	No swimming for 1 day	No fishing for 3 days	Granular endothall may not be applied within 75 feet of any drinking water well or within 250 feet of drinking water wells that are less than 30 feet deep. 14-day restriction on using treated water for irrigation, agricultural sprays, or domestic purposes. Extended restrictions on livestock watering and domestic uses may be required depending on label dosage details.
Sonar	Fluridone	Liquid or granular selective, systemic, herbicide	All submerged plants (monocot and dicot) are susceptible.	No restrictions. NY has a 24 hour restriction.	No restrictions	Do not apply with ¼ mile of a potable water intake at levels greater than 0.02 ppm. Water treated with fluridone should not be used for irrigation for 7 to 30 days, depending on the size of the lake or pond,

		absorbed through the roots				type of vegetation to be irrigated, and for of the product used.
Habitat	Imazapyr	Liquid or granular contact herbicide	All floating and emerged plants (monocot and dicot) are susceptible.	No swimming for 1 day	No restrictions	Do not apply with one-half mile upstream of an active potable water intake in flowing water (i.e., river, stream) or within one-half mile of an active potable water intake in a standing body of water. Do not apply to water used for irrigation, following product label.
Renovate 3	Triclopyr	Liquid systemic herbicide	Broadleaf (dicot) plants are susceptible.	No swimming for 1 day	No restrictions	Do not use treated water for irrigation for any plants, except established grasses for 120 days. This restriction may be lifted if the triclopyr level in intake water is determined to be non-detectable by laboratory analysis. Setback distances from potable water intakes, following product label.

Notification requirements: Occupants of adjacent riparian dwellings whose bottomlands are within the treatment area, or within 100 feet of treatment area, must be notified in writing at least 7 days, and not more than 45 days, before the initial chemical treatment.

Posting requirements: (a) For treatment areas less than 2 acres, Department approved posting signs must be posted along the shoreline of any treatment areas not more than 100 feet apart. (b) For treatment of areas greater than 2 acres, post as in (a) and post all access sites, boat launching areas, and public and private parks

Sources: Michigan Department of Environmental Quality (2005a, 2005b, 2007), Cerexagri Inc. (undated, Aqua-Kleen & Aquathol K labels), Applied Biochemists (2002), Aquacide Co. (2000), ELF Atochem North America Inc. (1996), SePRO (2003), Skogerboe et al. (2003), BASF (2003), SePRO (2007).

Table A-3
Volatility of Selected Herbicides in the Air
Herbicides Proposed for Non-Native Invasive Plant Control on Huron-Manistee National Forests.

Herbicide	Volatility Characteristics
2,4-D acetic acid	Volatile. It should not be applied under high temperatures or windy conditions (Tu et al. 2001). Salt formulations are much less volatile than the ester formulations (Putnam et al. undated).
Aminopyralid	No volatility concerns; however, care should be taken to avoid off-site physical spray drift (Dow AgroSciences Undated).
Clopyralid	Does not volatilize readily (Tu et al. 2001).
Dicamba	Reported to be relatively volatile. It can evaporate from leaf surfaces, and may evaporate from the soil (USDA Forest Service 2004b).
Endothall	Reported to be of low volatility (California EPA 1997)
Fluridone	Non-volatile (SePRO 2001), (Footprint 2008).
Fosamine ammonium salt	Not highly volatile (Tu et al. 2001)
Glyphosate	Does not readily volatilize (Tu et al. 2001).
Imazapic	Imazapic does not volatilize when applied in the field (Tu et al. 2001).
Imazapyr	Imazapyr does not volatilize readily when applied in the field. The potential, however, increases with increasing temperature, increasing soil moisture, and decreasing clay and organic matter content (Tu et al. 2001).
Metsulfuron methyl	Non-volatile (USDOE-Bonneville Power Adm. 2000), (Genfarm Crop Protection Pty Ltd. 2005).
Sethoxydim	Does not volatilize readily (Tu et al. 2001).

Triclopyr	Ester formulations can be volatile, and care should be taken during application. Salt formulation is much less volatile than the ester formulation (Tu et al. 2001).

Table A-4
Mobility and Persistence of Herbicides in Soil Herbicides Proposed for Non-Native Invasive Plant Control on Huron-Manistee National Forests.

Herbicide	Characteristics		
	Mechanisms of degradation	**Half-life in soil**	**Mobility**
2,4-D acetic acid	Degradation is primarily due to microbes in the soil	7 to 10 days (EXTOXNET-2,4-D, 1996).	Most formulations do not bind tightly with soils, and therefore have the potential to leach down into the soil and migrate off-site. However, in many instances, extensive leaching does not occur, most likely because of the rapid degradation of the herbicide.
Aminopyralid	Degradation by soil microbes and sunlight (Washington DOT undated).	32 to 533 days with a typical time of 103 days (Washington DOT undated).	Moderate-high (U.S. EPA 2005). Runoff of about 1% to 5% of the applied aminopyralid from predominantly clay soils might be expected depending on rainfall rates. Much less runoff is expected from loam soils and virtually no runoff is expected from predominantly sand soils.
Clopyralid	Clopyralid is degraded by soil microbes.	40 days	Does not bind strongly to soils. During the first few weeks, potential for leaching and possible contamination of groundwater is strong, but adsorption may increase over time.
Dicamba	Rapid metabolism by soil microbes (slower in anaerobic soil conditions), slow photodegradation (WSSA 2002)	<14 days under conditions amenable to rapid metabolism (WSSA 2002)	Low to medium leaching potential (mobile in soil but degrades rapidly) (WSSA 2002)

Herbicide	Characteristics		
	Mechanisms of degradation	**Half-life in soil**	**Mobility**
Endothall	Breaks down rapidly in water (WSSA 2002)	N/A (will only be used in water)	Information not available (WSSA 2002)
Fluridone	Broken down in water primarily by light. Some breakdown by microorganisms and aquatic plants. Microorganisms are the primary factor responsible for the degradation of fluridone in terrestrial soils (Siemering 2005 pp. 66-77).	The half-life of fluridone in sediment in an artificial pond under field conditions was 17 weeks (Siemering 2005 pp. 66-77).	Strongly adsorbed to organic matter in soil and in water. Extremely limited soil-activity or soil mobility (leaches slowly in soil). (USDOI, 2005).
Fosamine ammonium salt	Rapidly degraded by soil microbes, so it does not persist.	Average of 8 days (can range from 1 – 2 weeks.	Has limited mobility due to its rapid degradation, and because it binds readily with some soils
Glyphosate	Degradation is primarily due to soil microbes (Tu et al. 2001)	Average of 47 days (Tu et al. 2001)	Glyphosate has an extremely high ability to bind to soil particles, preventing it from being mobile in the environment (Tu et al. 2001).
Imazapic	Degradation primarily due to soil microbes.	120-140 days	Low or limited.
Imazapyr	Slow microbial metabolism and photolysis. Imazapyr is rapidly degraded by sunlight in aquatic solutions. In soils, however, there is little or no photodegradation of imazapyr.	1 to 5 months. Persistence in soils is influenced by soil moisture. In drought conditions, imazapyr could persist for more than one year.	Low-moderate. Imazapyr is a weak acid herbicide-environmental pH determines its environmental persistence and mobility. Below pH 5 the adsorption capacity of imazapyr increases and limits its movement in soil.

Herbicide	**Characteristics**		
	Mechanisms of degradation	**Half-life in soil**	**Mobility**
Metsulfuron methyl	Degraded by soil microbes and chemical hydrolysis	14-180 days. Average of 30 days. Breakdown is dependant on soil temperature, moisture content, and pH. Degrades faster under acidic conditions, and in soils with higher moisture content and higher temperature (EXTOXNET-Metsulfuron-methyl, 1996).	Moderate-high (Washington DOT 2006).
Sethoxydim	Sethoxydim is rapidly degraded by photolysis as well as microbes in the soil.	4 to 5 days	Does not bind strongly with soils, so it could potentially have high mobility, but degrades rapidly so there is limited movement.
Triclopyr	Triclopyr is rapidly degraded to triclopyr acid by photolysis, microbes in the soil, and hydrolysis.	30 days	Ester formulation binds readily with the soil, giving it low mobility. The salt formulation binds only weakly in soil, giving it higher mobility. However, both formulations are rapidly degraded to triclopyr acid, which has an intermediate adsorption capacity, thus limiting mobility.

Note: Unless otherwise noted, data are from Tu et al. 2001.

Table A-5. Herbicide Solubility, Half Life, and Aquatic Toxicity Data.

Herbicide	Solubility	Half-life	Aquatic Toxicity and Bioaccumulation
2,4-D	Water soluble at pH>7. At lower pH, is more likely to adsorb to organic particles present in water, thus increasing its persistence (Tu et al. 2001).	1 week to several weeks (EXTOXNET-2,4-D, 1996).	Many ester formulations are toxic to fish as well as aquatic invertebrates. Some formulations, especially many salt formulations, are registered for use against aquatic weeds and are non-toxic to aquatic species. Conflicting reports on bioaccumulation. According to some studies, nearly all of the dose of 2,4-D is excreted in urine and does not accumulate in animals (EXTOXNET-2,4-D, 1996). Field studies indicate that application of 2,4-D amine or ester to a lake, at high application rates, did not result in the bioconcentration of 2,4-D in game fish (USDA Forest Service 2006a). According to other studies, 2,4-D can accumulate in fish and aquatic invertebrates. However, highest concentrations of 2,4-D were reached shortly after application, and dissipated within three weeks after exposure (Tu et al. 2001).
Aminopyralid	Soluble in water. Unbuffered: 2.48 g/L 18°C (USEPA 2005).	104 days (USEPA 2005).	Aminopyralid is practically non toxic to fish and aquatic invertebrates (U.S. EPA 2005). Aminopyralid has been shown to be practically non-toxic to birds, fish, honeybees, earthworms, and aquatic invertebrates. Aminopyralid is slightly toxic to eastern oyster, algae and aquatic vascular plants. Aminopyralid is not expected to bioaccumulate in fish tissue. There are no acute or chronic risks to non-target endangered or non-endangered fish, birds, wild mammals, terrestrial and aquatic invertebrates, algae or aquatic plants (USEPA 2005).

Clopyralid	Highly soluble in water and will not bind with particles in water column (Tu et al. 2001).	8 to 40 days (Tu et al. 2001).	Low toxicity to aquatic animals (Tu et al. 2001). No evidence of bioaccumulation in fish tissues (USDA Forest Service 2004a).
Dicamba	Highly water soluble (WSSA 2002).	Low to medium leaching potential, but degrades rapidly. Low potential for runoff due to rapid degradation (WSSA 2002).	Relatively low toxicity to fish and aquatic invertebrates (Daphnia 48-hr. TL50 of 110 mg/L bluegill, sunfish and rainbow trout 96-hr. TL50 of 135 mg/L). No information on bioaccumulation (WSSA 2002).
Endothall	Water solubility of 100 g/L at 25ºC and pH 7 (WSSA 2002).	Breaks down rapidly in water (WSSA 2002)	While only 0.5 to 5 parts per million (ppm) endothall applied as Aquathol K are necessary for aquatic weed control, some fish species are tolerant to more than 100 ppm (Cerexagri, undated Aquathol K label).
Fluridone	Low solubility in water. 12 mg/L at 25°C (Siemering 2005).	Aquatic half-life is 5-60 days with an average of 20 days in water; under anaerobic aquatic conditions half-life is nine months (Siemering 2005).	Low toxicity to invertebrates, fish, and other aquatic wildlife, and humans. (Mattson et al. 2004). Fluridone does not significantly bioaccumulate or biomagnify in fish. Consumption of fish from treated water does not pose a threat to human health (Washington 2000).
Fosamine ammonium salt	Highly soluble in water; however it is stable and persistent once it enters an aquatic system (Tu et al. 2001).	Stable & persistent in water. Degraded rapidly through microbial activity in aquatic sediments (Tu et al. 2001).	Low toxicity to fish and aquatic invertebrates (Tu et al. 2001). No evidence exists that FAS bioaccumulates in fish (Tu et al. 2001). Can be applied to floodplains where no surface water is present and to low-lying areas where water is drained but may be isolated in pockets due to uneven land use (DuPont 2003).
Glyphosate	Rapidly dissipated through adsorption to suspended and bottom sediments (Tu et al. 2001).	12 days to 10 weeks (Tu et al. 2001).	Technical grade is moderately toxic to fish. A formulation registered for aquatic use is practically non-toxic to fish, aquatic invertebrates, and amphibians (Tu et al. 2001). Does not bioaccumulate in fish (USDA Forest Service 2003b).

Imazapic	Soluble in water. 2200 mg/L at 25° C (Tu et al. 2001).	1-2 days. Degraded by sunlight (Tu et al. 2001).	Imazapic is of low toxicity to birds and mammals. Imazapic does not bioaccumulate in animals, as it is rapidly excreted in urine and feces. It is therefore, essentially non-toxic to a wide range of non-target organisms, including mammals, birds, fish, aquatic invertebrates, and insects (Tu et al. 2001).
Imazapyr	Soluble in water; in the range of 9740–11,272 mg L−1 and is somewhat pH dependent (Tu et al. 2001).	Typically 10 days in soil. Microbes and sunlight break down imazapyr in the environment. Potential to leach to groundwater is high; surface runoff potential is high, and potential for loss on eroded soil is intermediate (Tu et al. 2001).	Imazapyr is not highly toxic to birds and mammals, but some formulations (inert ingredients) can cause severe, irreversible eye damage. Imazapyr is excreted by mammalian systems rapidly with no bioaccumulation. It has a low toxicity to fish, and algae and submersed vegetation are not affected (Tu et al. 2001).
Metsulfuron methyl	Soluble in water. 2790 mg/l in water (pH 7) (EXTOXNET 1996 Metsulfuron-methyl).	14-180 days with a typical time of 30 days (Washington DOT 2006).	Practically non-toxic to bees, aquatic vertebrates and invertebrates, and terrestrial animals. Studies suggest low potential for bioconcentration (USDA Forest Service 2004e).
Sethoxydim	Soluble in water and does not bind strongly with soils (Tu et al. 2001).	Rapidly degraded by light in less than 1 hour (Tu et al. 2001).	Moderately to slightly toxic to aquatic species (Tu et al. 2001). Tendency to dissipate quickly precludes any bioaccumulation in the food chain (Tu et al. 2001).

Triclopyr	Salt formulation is water-soluble. The ester formulation is insoluble in water (Tu et al. 2001).	Salt formulation can degrade in sunlight with a half-life of several hours. The ester formulation takes longer to degrade (Tu et al. 2001).	Ester formulation is extremely toxic to fish and aquatic invertebrates. Acid and salt formulation is slightly toxic to fish and aquatic invertebrates (Tu et al. 2001). The hydrophobic nature of the ester formulation allows it to be readily absorbed through fish tissues, where it is converted to triclopyr acid, which can be accumulated to a toxic level. However, most authors concluded that if applied properly, triclopyr would not be found in concentrations adequate to harm aquatic organisms (Tu et al. 2001).

Table A-6
Toxicity Data for Birds, Fish, and Insects
Herbicides Proposed for Non-Native Invasive Plant Control on Huron-Manistee National Forest.

Herbicide Formulation	**Avian Receptors**				**Terrestrial Invertebrates**		**Aquatic Receptors**			
(Technical product unless specific formulation noted)	Bobwhite Quail		Mallard Duck		Earth-worm	Honey bee	Daphnia	Bluegill	Rainbow Trout	Amphibian Tadpoles
	Oral LD50	8-day dietary LC50	Oral LD50	8-day dietary LC50	LC50	Topical LD50	48-hour LC50	96-hour LC50	96-hour LC50	48-hour LC50
	mg/kg BW	ppm (in food)	mg/kg BW	ppm (in food)	ppm (in soil)	ug/bee	Mg/L (in water)			
2,4-D										
2,4-D acid	500 - 668	>5620	>1000	>5620	2 – 350	11.5	>25	263	358 - 377	359
2,4-D Dimethyl-amine salt	500	>5620		5620			184	524	377	
2,4-D Isooctyl ester		>5620	663	>5620			5.2	>5	>5	
Aminopyralid										
Aminopyralid acid	>2250	>5556 5-day mg/kg diet	>2623 mg a.e./kg diet	>5496 5-day mg/kg diet		>100	98.6	>100	>100	95.2 96-hr. Leopard frog
MILESTONE™	>2000	>5556 5-day mg/kg diet	>2000	>5496 5-day mg/kg diet				>100	>100	
Clopyralid										
Clopyralid acid		>4640	1465	>4640	1000	>100	232	125	104	413
Dicamba										
Dicamba acid	216	>10000	1373	>10000			110 (TL50)	135 (TL50)	135 (TL50)	
BANVEL™		>4640	>2510	>4640			1600	>1000	1000	
BANVEL SGF™		>10000	>4640	>10000			38.1	706	558	
WEEDMASTER™ Dicamba+2,4-D		>4640	>4640	>4640			>1800	>1000	>1000	
Endothall										
Endothall		>5,000		>5,000			72-319.5	316-501.2	107-528.7	

Fluridone										
Fluridone	>13135	>4350	>2270	>4540		>1088	1.3	8.2	4.25	
SONAR A. S.™	>13135	>4350	>2270	>4540		>1088	2.1-3.9	8.2	4.2	
Fosamine ammonium salt										
Fosamine ammonium salt	>5000	>5620	>5000	>5620		Non-toxic	1524	590	330	

Herbicide Formulation	Avian Receptors				Terrestrial Invertebrates		Aquatic Receptors			
(Technical product unless specific formulation noted)	Bobwhite Quail		Mallard Duck		Earthworm	Honey bee	Daphnia	Bluegill	Rainbow Trout	Amphibian Tadpoles
	Oral LD50	8-day dietary LC50	Oral LD50	8-day dietary LC50	LC50	Topical LD50	48-hour LC50	96-hour LC50	96-hour LC50	48-hour LC50
	mg/kg BW	ppm (in food)	mg/kg BW	ppm (in food)	ppm (in soil)	ug/bee	Mg/L (in water)			
Glyphosate										
Glyphosate acid	>4640	>4640		4640		>100	780	120	86	81 - 121
Glyphosate trimethylsulfo-nium salt		>5000	950	>5000		>62.1	71	3500	1800	
ROUNDUP™					>5000	>100	5.3	2.8 - 5.8	8.2 - 25	0.3 - 1
RODEO™							930	>1000	>1000	5407
Imazapic										
Imazapic	>2150	>5000	>2150	>5000		>100	100	>100	>100	
PLATEAU™	>2150	>5000	>2150	>5000		>100	100	>100	>100	
Imazapyr										
Isopropyl or isopropylamine salt	>2150	>5000	>2150	>5000		>100	>100	>180	>110	
CHOPPER™				>5000		>100	>100		>100	
Metsulfuron methyl										
Metsulfuron methyl	>5620	>5620	>5620	>5620	>1000 mg/kg	>25 - >100	>150	>150	>150	
ESCORT™ ESCORT XP™	>5620	>5620	>2510	>5620	>1000 mg/kg	>100	>150	>150	>150	

Sethoxydim										
Sethoxydim		>5620	>2510	>5620				100	32	
Triclopyr										
Triclopyr acid		2934	1698	>5620		>100	133	148	117	
Triclopyr butoxyethyl ester		5401-9026		>5401		>100	1.7	0.36	0.65	0.8 – 9.3
Triclopyr triethylamine salt		>10000	3176	>10000		>100	775 - 1496	891	552 - 613	162

LD50 - Lethal Dose to 50% of receptors; LC50 - Lethal Concentration to 50% of receptors; TL50 - Threshold Level to 50% of receptors.

Fosamine Ammonium Salt (FAS, Krenite) data are from DuPont (2004) and Petersen (2001). Endothall (Aquathol K) data are from Cerexagri (2003).

2,4-D data are from USDA (2006a), Extonet (1996a). Roundup data are from Relyea (2005). Triclopyr data are from Antunes-Kenyon & Kennedy (2004). Imazapyr data are from EPA (2006), BASF (2001), BASF (2008)a, BASF (2008)b, USDA Forest Service (2004d). Fluridone data are from Siemering et al., (2005), Cornell University (1986), Mattson et al. (2004), SePRO (2001), and Washington State Dept. Agri. (2003). Metsulfuron-methyl data are from Dupont (2005a), Dupont (2005b), Dupont (2007a), Dupont (2007b), Extonet (1996b), Washington Department of Transportation (Undated), Agriculture Canada (1987). Imazapic data are from USDOI (2005), BASF (2008). Aminopyralid data are from USDA Forest Service (2007), U.S. Office of Prevention (2007), Texas State DOT (2006), DowAgroScience (2006)

Table A-7
Forest Service Ecological Risk Assessment Information
Herbicides Proposed for Non-Native Invasive Plant Control on Huron-Manistee National Forests Forest.

Risk Assessment Application Rate	Terrestrial Mammals	Birds	Insects	Fish & Other Aquatic Receptors
2,4-D (Source: USDA Forest Service 2006a)				
1.0 lb a.i./acre (average rate) 2.0 lb a.i./acre (maximum rate)	Except for accidental exposures, applications at average or maximum rates are not likely to cause adverse effects. Small mammals exposed to direct spray could display subclinical toxic effects. If foliage treated with 2,4-D is the sole diet of a mammal, subclinical toxic effects are possible.	Except for accidental exposures, applications at average or maximum rates are not likely to cause adverse effects. Acute toxicity studies suggest that birds are somewhat less sensitive than mammals. Studies suggest that 2,4-D sprayed directly onto avian eggs at rates up to 10 lb/Ac. (substantially higher than label rate) have no effect.	Bees exposed to direct sprays could experience substantial mortality.	Direct application of 2,4-D to water at rates used by the Forest Service could cause mortality of aquatic receptors (including MIS brook trout or mottled sculpin).. Formulations approved for aquatic use would be used for Eurasian water-milfoil control.
Aminopyralid (Source: USDA Forest Service 2007)				
0.03 to 0.11 lb a.e./acre	The most common effects noted involve changes in the gastrointestinal tract and decreased body weight. Incoordination has been noted in gavage studies with rabbits. Other than these effects,	Results of acute exposure studies in birds indicate that avian species appear no more sensitive than experimental mammals to aminopyralid in terms of acute lethality. In terms of non-lethal effects,	There is no indication that aminopyralid is toxic to honeybees.	The acute toxicity studies in fish are all unremarkable. No mortality was observed at the maximum concentration tested. The U.S. EPA has classified aminopyralid as practically

Risk Assessment Application Rate	Terrestrial Mammals	Birds	Insects	Fish & Other Aquatic Receptors
	aminopyralid does not appear to cause specific target organ toxicity in mammals. Aminopyralid apparently has low toxicity to animals as a result of spray or ingestion.	however, birds may be somewhat more sensitive than mammals to aminopyralid after gavage exposures. Aminopyralid apparently has low toxicity to animals as a result of spray or ingestion.		non-toxic to aquatic-phase amphibians.

Risk Assessment Application Rate	Terrestrial Mammals	Birds	Insects	Fish & Other Aquatic Receptors
Clopyralid (Source: USDA Forest Service 2004a)				
0.1 lb a.i./acre (typical rate) 1.0 lb a.i./acre (maximum rate)	Reported to be relatively non-toxic, with little potential for adverse effects.	Reported to be relatively non-toxic, with little potential for adverse effects. However, based on limited available toxicological data.	Reported to be relatively non-toxic to bees, with little potential for adverse effects. However, based on limited available toxicological data.	Reported to be relatively non-toxic, with little potential for adverse effects. However, aquatic plants somewhat more sensitive.
Dicamba (as Vanquish, the diglycolamine salt of dicamba) (Source: USDA Forest Service 2004b)				
2 lb a.i../acre (foliar application) 1.5 lb a.i./acre (cut surface application) (VANQUISH)	No plausible and substantial hazard under normal conditions of Forest Service use.	No plausible and substantial hazard under normal conditions of Forest Service use.	No information.	No plausible and substantial hazard under normal conditions of Forest Service use.
Glyphosate (Source: USDA Forest Service 2003b)				
2 lb a.i./acre (average rate) 7 lb a.i./acre (maximum rate)	Effects resulting from average application rate are minimal. Some risk exists for large mammals consuming foliage for an extended period of time in areas treated with maximum	Effects resulting from average application rate are minimal. Some risk exists for small birds consuming insects for an extended period of time from areas treated with maximum application	Effects resulting from average application rate are minimal. Some risk from maximum application rate to bees exposed to direct spray.	Effects resulting from average application rate are minimal. Some risks exists to fish near areas treated with maximum application rate using some of the more toxic formulations not

	application rate.	rate.		labeled for use in aquatic settings.
Imazapic (Source: USDA Forest Service 2004c)				
.01 lb a.e. /acre	Low	Low	Low	Very little potential risk to applicators or general public.
Imazapyr (as Arsenal, Chopper, Stalker) (Source: USDA Forest Service 2004d)				
0.45 lb a.i. /acre	Available toxicity studies are relatively complete, including studies in three mammalian species (dogs, rats, and mice) and several reproduction studies in two mammalian species (rats and rabbits) indicate that imazapyr is not likely to be associated with adverse effects at relatively high-dose levels.	While toxicity studies on birds are less extensive than those on mammals, no adverse effects have been noted in birds.	Limited toxicological data is available. However, the toxicity of imazapyr to insects may be similar to the toxicity of this compound to mammals, that is, relatively non-toxic.	Limited toxicological data is available. There exists some research that suggests imazapyr is moderately toxic to other fish species.
Metsulfuron methyl Source: USDA Forest Service 2004e)				
.03 lb a.i./acre	Low	Low	Low	Low
Sethoxydim (Source: USDA Forest Service 2001b)				
0.09375 lb/acre (minimum rate) 0.375 lb/acre (maximum rate)	No substantial risk at maximum rates.	No substantial risk at maximum rates.	Studies on beetle larvae suggest that rates exceeding maximum rates are relatively non-toxic.	No substantial risk at maximum rates. However, limited toxicological data available. Potential for risk to aquatic plants from maximum rates is borderline.
Triclopyr (Source: USDA Forest Service 2003c)				
1 lb a.i./acre (average rate)	No substantial risk at average rate.	No substantial risk at average rate.	No information.	No substantial risk when triethylamine (TEA) salt

10 lb a.i./acre (maximum rate)	Some risk for mammals exposed via direct spray or consuming sprayed vegetation when applied at maximum rate.	Some risk for large birds exposed via direct spray or consuming sprayed vegetation when applied at maximum rate.		formulations are applied at average rate. Some risk to aquatic species when butoxyethyl ester (BEE) formulations are applied at average rate. Substantial risk when BEE formulations applied at maximum rate.

Note: All rates noted, including "maximum rate," are labeled rates. Forest Service Ecological Risk Assessments have not been completed for Endothall, Fosamine Ammonium Salt (FAS), or Fluridone. See other Appendix tables for comparable information.
NA = Not Available

Table A-8
Mammalian Toxicity Data
Herbicides Proposed for Non-Native Invasive Plant Control on Huron-Manistee National Forest.

Herbicide	**Acute Toxicity**						**Chronic Toxicity**		
(Technical product unless specific formulation noted)	Oral LD50 (rat)	Dermal LD50 (rabbit)	4-Hour Inhalation LC50 (rat)	Skin Irritation (rabbit)	Skin Sensitization (guinea pig)	Eye Irritation (rabbit)	24-Month Dietary NOEL (mouse)	24-Month Dietary NOEL (rat)	12-Month Dietary NOEL (dog)
	mg/kg BW		mg/L				mg/kg BW/day		
2,4-D									
2,4-D acid	639	>2000	1.79	None	No	Severe	5	5	1
2,4-D Dimethylamine salt	>1000	909	3.5	None	No	Severe	Chronic toxicity data available only for technical 2,4-D acid		
2,4-D Isooctyl ester	1045	>5000	5.7	None	Yes	Moderate			
Aminopyralid									
Aminopyralid	>5000	>5000	>5.79	No	No	Irritation	1000 90-days	1000 90-days	99
Milestone™	>5000	>5000	>5.79	No	No	Irritation	1000 90-days	1000 90-days	99

Clopyralid									
Clopyralid acid	>5000	>2000	>1.3 (unspec.)	V. Slight	No	Severe	500 (18mo) (mouse)	50 (rat)	100 (dog)
STINGER™	>5000	NA	NA	NA	NA	NA	Chronic toxicity data available only for technical clopyralid acid		
Dicamba									
Dicamba acid	1707	>2000	9.6	Slight	Possible	Extreme	115 (18mo)	125	60
BANVEL™	2629	>2000	>5.4	Moderate	No	Extreme	Chronic toxicity data available only for technical dicamba acid		
BANVEL 720™	2500	NA	NA	NA	NA	NA			
BANVEL SGF™	6764	>20000	>20.23	Slight	NA	Minimal			
WEEDMASTER™ Dicamba+2,4-D	>5000	>20000	>20.3	Minimal	NA	Minimal			

Endothall									
Aquathol K™	99.5	2000	0.83	None		Irrev. damage	Endothall-K: Long-term dietary administration produced no adverse effects in rats.		
Hydrothol 191™	233.4	480.9	0.7	Severe	No	Severe	Technical active ingredient: Long-term dietary administration to rats and mice produced effects in the glandular stomach.		
Endothall diacid	51	NA	NA	NA	NA	NA	NA	>300	NA
Fluridone									
Fluridone	>10000	>2000	LC0 >2130 mg/m3	No	No	Moderate Irritation	1301	503 18 mo.	75
SONAR A.S.™	>10000	>2000	LC0 >2130 mg/m3	Slight	NA	Slight	NA	NA	NA
Fosamine Ammonium Salt									
Fosamine ammonium salt	24400	>1683	NA	Mild	No	Slight	NA	NA	10000 (6mo) (dog)
KRENITE S™	>5000	>5000	2.75	Mild-moderate	No	Moderate-severe	Chronic toxicity data available only for technical fosamine am. salt		
Glyphosate									
Glyphosate acid	5600	>5000	NA	None	No	Slight	4500	400	500
Glyphosate isopropylamine salt	>5000	>5000	NA	None	No	Slight	Chronic toxicity data available only for technical glyphosate acid		
Glyphosate trime-thylsulfonium salt	748	>2000	>5.18 (unspec.)	Mild	Mild	Mild			
ROUNDUP™	>5000	>5000	3.2	None	No	Moderate			
RODEO™	>5000	>5000	1.3	None	No	None			
LANDMASTER™ (Glyphosate+2,4D)	3860	6366	NA	Moderate	NA	Severe			
Imazapic									

Imazapic	>5000	>5000	>4.83	None	No	Slight	>1288	>1133	150 (LOAEL)
PLATEAU™	>5000	>5000	>2.38	Non-irritating	No	Non-irritating			
Imazapyr									
Isopropyl or isopropylamine salt	>5000	>2000	>1.3 – >4.62	Mildly irritating	No	Mildly to irritating	>100	>100	>100
ARSENAL™	>5000	>2000	>4.62	Mildly irritating	No	Non-irritant	Long-term studies in rats and mice produced no carcinogenic effect.		NA
CHOPPER™	>5000	>5000	1.58	Irritating	Slightly sensitizing	Moderately irritating			
HABITAT™	>10000	>2000	4.62	Mildly	No	Non-irritating	NA	NA	NA
Metsulfuron methyl									
Metsulfuron methyl	>1680	>5000	>2.7	Very slight to defined	None	Mildly	5000 ppm 18 mo	500 ppm	500 ppm (males) 5000 ppm (females)
ESCORT & ESCORT XP™	>5000	>2000	>5.3	Very slight to severe	None	Slight	666 (18mo)	25	125
Sethoxydim									
Sethoxydim	2676	>5000 (rat)	6.1	None	No	None	18	NA	8.86
POAST™	4.1	>5000 (rat)	>4.6	Moderate	No	Moderate	Chronic toxicity data available only for technical sethoxidim		
POAST PLUS™	>2200	>2000 (rat)	>7.6	Slight	No	Slight			
Triclopyr									
Triclopyr acid	713	>2000	NA	None	Positive	Mild	5.3 (22mo)	3	NA
GARLON 3A™	2574	>5000	>2.6 (unspec.)	NA	NA	Severe	Chronic toxicity data available only for technical triclopyr acid		
GARLON 4™	1581	>2000	>5.2 (unspec.)	Moderate	Positive	Slight			

Source: Herbicide Handbook (WSSA 2002), DuPont (2004), Cerexagri (2003), Elf Atochem (2000), Cornell University (1986)
Mattson et al. (2004), BASF (2000)
NA = Not Available

Table A-9. Determinations for Federally Listed Species.

Species	Federal Status	Text	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Indiana Bat	Endangered	5.1.1	MA-NLAA	MA-NLAA	MA-NLAA	MA-NLAA
Bald Eagle	Delisted July 2007 (RFSS)	5.1.2	MA-NLAA	MA-NLAA	MA-NLAA	MA-NLAA
Kirtland's Warbler	Endangered	5.1.3	MA-NLAA	MA-NLAA	MA-NLAA	MA-NLAA
Great Lakes Piping Plover	Endangered	5.1.4	MA-NLAA	MA-NLAA	MA-NLAA	MA-NLAA
Karner Blue Butterfly (KBB)	Endangered	5.1.5	MA-ILAA	MA-NLAA	MA-NLAA	MA-NLAA
Pitcher's Thistle	Threatened	5.1.6	MA-ILAA	MA-NLAA	MA-NLAA	MA-NLAA

MA-ILAA = May Affect and Is Likely to Adversely Affect
MA-NLAA = May Affect but is Not Likely to Adversely Affect

Table A-10. Determinations for RFSS Aquatic Species.

Habitat	Focus Species	Text	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Large Rivers	Lake Sturgeon	5.2.1.1	MILT	MINT	MINT	MINT
Medium to Large Streams	Channel Darter	5.2.1.2	MILT	MINT	MINT	MINT
Clear Cool Headwaters	Creek Heelsplitter	5.2.1.3	NI	NI	NI	NI
Clear Vegetated Lakes	Pugnose Shiner	5.2.1.4	MILT	MINT	MINT	MINT

NI = No Impact
MINT = May Impact individuals but is Not likely to cause a Trend toward federal listing or loss of viability
MILT = May Impact individuals and is Likely to result in a Trend toward federal listing or loss of viability.

Table A-11. Determinations for RFSS Plant Species Habitats.

Habitat	Text	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Subirrigated Moist Forest/Thicket	5.2.2.1	MINT	MINT	MINT	MINT

Clay-Loam Forest/Rich Mesic Hardwood Forest	5.2.2.2	MINT	MINT	MINT	MINT
Forest with Needle Duff Habitat	5.2.2.3	MINT	MINT	MINT	MINT
Hardwood Forest Openings	5.2.2.4	MINT	MINT	MINT	MINT
Semi-open Mesic Depressions	5.2.2.5	MINT	MINT	MINT	MINT
Barrens (Oak Woodlands/Pine Woodlands/Pine Barrens/Prairie Woodland)	5.2.2.6	MINT	MINT	MINT	MINT
Great Lakes Barrens/Open Dunes/ Wooded Dunes/ Wooded Dune Swale/ Interdunal Wetland	5.2.2.7	MINT	MINT	MINT	MINT
Dry Sand Prairie	5.2.2.8	MINT	MINT	MINT	MINT
Open Dry Sand	5.2.2.9	MINT	MINT	MINT	MINT
Mesic Sand Prairie/Northern Wet-Mesic Prairie	5.2.2.10	MINT	MINT	MINT	MINT
Wet-Mesic Prairie/Meadow	5.2.2.11	MINT	MINT	MINT	MINT
Riparian – Forested (Includes Southern Floodplain Forest)	5.2.2.12	MINT	MINT	MINT	MINT
Riparian – Non-Forested	5.2.2.13	MINT	MINT	MINT	MINT
Swamp/Hardwood Conifer Swamp (Includes Southern Swamp)	5.2.2.14	MINT	MINT	MINT	MINT
Sub-Irrigated Forest	5.2.2.15	MINT	MINT	MINT	MINT
Bog	5.2.2.16	MINT	MINT	MINT	MINT
Coastal Plain Marsh/Intermittent Wetland	5.2.2.17	MINT	MINT	MINT	MINT
Wet Exposed Mineral Soils	5.2.2.18	MINT	MINT	MINT	MINT
Aquatic Pond-Lake	5.2.2.19	MILT	MINT	MINT	MINT
Marsh	5.2.2.20	MINT	MINT	MINT	MINT
Localized Wet Depressions-Swales in Oak/Swales in Pine/Vernal Pools	5.2.2.21	MINT	MINT	MINT	MINT
Lake Shorelines (Acid Shoreline/Calcareous Shoreline/Neutral Shoreline)	5.2.2.22	MINT	MINT	MINT	MINT
Cedar Swamps	5.2.2.23	MINT	MINT	MINT	MINT

MINT = May Impact individuals but is Not likely to cause a Trend toward federal listing or loss of viability

Table A-12. Determinations for RFSS Wildlife Habitats.

Habitat	Focal Species		Section	Alt. 1	Alt. 2	Alt. 3	Alt. 4
Beach/Dune	Piping Plover		5.2.3.1	MINT	MINT	MINT	MINT
River/Streams	Wood Turtle		5.2.3.2	MINT	MINT	MINT	MINT

Ponds/Lakes (Larger)	Common Loon		5.2.3.3	MINT	MINT	MINT	MINT
Ponds/Lakes (Smaller)	Blanding's Turtle		5.2.3.4	MINT	MINT	MINT	MINT
Marsh	American Bittern	Northern Harrier	5.2.3.5	MINT	MINT	MINT	MINT
Bogs/Fens	Olive-sided Flycatcher		5.2.3.6	MINT	MINT	MINT	MINT
Shrub/Scrub Wetlands	Golden-winged Warbler		5.2.3.7	MINT	MINT	MINT	MINT
Riparian/Low-land HW/ Floodplain (Mid – Late)	Cerulean Warbler	Red-shoulder Hawk	5.2.3.8	NI	MINT	MINT	MINT
Riparian/Low-land HW/ Floodplain (Early – Mid)	Eastern Massasauga		5.2.3.9	MINT	MINT	MINT	MINT
Lowland Conifer/Boreal (Mid – Late)	Black-backed Woodpecker		5.2.3.10	NI	MINT	MINT	MINT
Oak/Pine (Late)	Red-headed Woodpecker		5.2.3.11	NI	MINT	MINT	MINT
Oak/Pine (Early – Mid)	Whip-poor-will		5.2.3.12	MINT	MINT	MINT	MINT
Mixed Hardwoods (Late)	Northern Goshawk	Wood Thrush	5.2.3.13	NI	MINT	MINT	MINT
Aspen/Birch (Early)	Golden-winged Warbler		5.2.3.14	MINT	MINT	MINT	MINT
Red/White Pine/Spruce	American Marten		5.2.3.15	NI	MINT	MINT	MINT
Jack Pine (Early – Open)	Michigan Bog Grasshopper		5.2.3.16	MINT	MINT	MINT	MINT
Jack Pine (Mid Successional)	Kirtland's Warbler		5.2.3.17	MINT	MINT	MINT	MINT
Jack Pine (Mid – Late Successional)	Spruce Grouse		5.2.3.18	NI	MINT	MINT	MINT
Pine Barrens	Dusted Skipper		5.2.3.19	MINT	MINT	MINT	MINT
Savanna (Oak Pine Barrens)	Karner Blue Butterfly	Red-headed Wood-pecker	5.2.3.20	NI	MINT	MINT	MINT

Grassland (Large Openlands)	Henslow's Sparrow	Bobolink	5.2.3.21	MINT	MINT	MINT	MINT
Grassland (Smaller Openlands)	Eastern Box Turtle		5.2.3.22	MINT	MINT	MINT	MINT
Dry Prairie (Large)	Upland Sandpiper		5.2.3.23	MINT	MINT	MINT	MINT
Dry Prairie (Large or Smaller)	Ottoe Skipper		5.2.3.24	MINT	MINT	MINT	MINT

NI = No Impact
MINT = May Impact individuals but is Not likely to cause a Trend toward federal listing or loss of viability

Table A-13 Herbicide Types of Usage and Their Characteristics

Herbicide	Sample Trade names	Target plants	Selectivity	Site selection	Time of Application	Method of Application
2,4-D	Weed-B-Gon, Brash, many others	Broadleaf herbs & woody seedlings	Broad Spectrum, selective only. Kills dicots.	Would be considered for use if other herbicides did not work. Upland where groundwater is > 10 feet deep.	Growing season preferred.	Ground broadcast or spot treatment
2,4-D (aquatic-approved)	Aqua-Kleen, Navigate, Aquicide	Eurasian water-milfoil	Broad Spectrum	Lakes.	Spring or early Summer.	Air, surface, or subsurface
Clopyralid	Stinger, Transline, Curtail	Herbaceous plants, such as spotted knapweed, crown vetch Canada thistle, wild parsnip, spot spray only, it affects native plants of the sunflower and pea families as well	Most Conifer and hardwoods are tolerant. Well suited for NNIS control and wildlife management.	Generally would not be used on well-drained soils where water table is within 10 feet of the surface due to rapid movement through soil.	Growing season Aug-Oct in combination with Accord or Arsenal for(legumes such as mimosa).	Ground broadcast applications and cut-stump.
Dicamba	Banvel II, Vanquish	Broadleaf herbs	Selective	Often a secondary ingredient with 2,4-D. Same	Can be used on dormant Multiflora Rose, but timing varies	Ground , cut-stump or basal bark applications.

				restrictions as 2,4-D.	on target species.	
Endothall	Aquathol K, Hydrothol 191	Broad range of aquatic plants	Non-selective Contact herbicide	Ponds, lakes and canals.	Growing season.	Surface or subsurface.
Fosamine ammonium salt	Krenite	Woody plants		Would be tried as foliar spray on large, dense, infestations to avoid impacts to neighboring herbs.	Mid-summer to defoliation in fall.	Ground.
Glyphosate	Round-Up, Round-Up Pro, many others	Annual and perennial grasses, herbaceous plants and woody plants (non-selective). Same as above for aquatic areas	Non-selective	Uplands	Year round applications.	Ground or cut-stump.
Glyphosate (wetland-approved)	Rodeo, Accord	Non-selective. Would be targeted against purple loosestrife, buckthorn, and European swamp-thistle.	Broad Spectrum	Wetlands. Herbicide of first choice for non-aquatic wetland sites. Also recommended for young pine plantations in late summer to early fall	Sept-Oct in combination with Transline(legumes such as mimosa).	Ground

				applications.		
Sethoxydim	Poast, Vantage, Rezult	Grasses (Smooth brome and reed canary grass).	Selective	Minimum buffer of 150 feet from surface water.		
Triclopyr	Garlon 3A, Pathfinder II, Access, Brush-B-Gon, Renovate	Broadleaf weeds and woody trees and shrubs.	Broad Spectrum	Uplands and wetlands.	Woody plants as foliar application, basal bark and cut-stump treatment. Herbaceous plants, spot spray only. Still works in freezing temperatures.	Ground
Triclopyr	Renovate 3	Milfoil species Nuphar (spatterdock), Parrotfeather, Pennywort, Phragmities Alligatorweed, American lotus, American frogbit, aquatic soda apple, Eurasian watermilfoil, Pickerelweed, purple	Broad Spectrum	Ponds, lakes, canals, and shorelines.	Spring or early summer.	Surface, subsurface.

		loosestrife, Waterhyacinth, Waterlily, Watershield, Water primrose, Broadleaf and woody vegetation on shorelines				
Aminopyralid	Milestone	Absinth wormwood, Bull thistle, Canada thistle, Diffuse knapweed, Kudzu, Musk thistle, Orange and yellow Hawkweed, Oxeye daisy, Plumeless thistle, Russian knapweed, Sowthistles, Spotted knapweed, Sulphur cinquefoil, Tropical soda apple, Yellow	Selective to most cool- and warm-season perennial grasses.	Upland to the water's edge.	Controls annual, biennial and perennial weeds both pre and post emergent. Wide window of application, extending through the fall.	Ground in broadcast or spot treatment.

		starthistle				
Fluridone	Sonar A.S.	Floating: common duckweed. Emersed: spatterdock, water-lily. Submersed: watermilfoil, hydrilla, elodea's coontail	Selectivity is dependent upon dosage, time of year, stage of growth, method of application and water movement.	For use in aquatic areas where there is little desired vegetation present and where other chemicals have failed due to an abundance of a hard to control species such as Eurasian water-milfoil or hydrilla.	Use during active growth of the target species.	Surface or Subsurface applications.
Imazapic	Plateau	Used where desirable warm season grasses are present.	Selective herbicide.	Recommended for weed control during native grass establishment.	Use in fall when native plants are dormant for leafy spurge control, spot spraying before killing frost when milky sap still emits from broken stem. May be applied in dormant or growing season.	Ground
Imazapyr	Arsenal	Hardwood trees and brush.	Broad spectrum herbicide.	Recommended for use on large woody invasive	May be used all year as a pre or post emergent.	Apply by ground or cut-stump application.

				such as Tree of Heaven.		
Metsulfuron methyl	Escort	Annual and perennial weeds and woody plants. Herbaceous plants, such as spotted knapweed, Grecian foxglove, garlic mustard, wild parsnip, and some woody to 3 years plants. It affects native plants of the sunflower, parsley, and pea families as well.	Selective herbicide which conifers and hardwoods tolerate well.	Recommended at low use rates to control noxious weeds, brush, and problem broadleaves on sites with excellent grass tolerance.	Best if used as a post emergent. Best if applied at bud/bloom or fall rosette stage prior to cold weather or hardening off.	Ground